6.0 Ecological Monitoring

6.1 Introduction

The Ecology Group conducts ecological monitoring of the Site's ecological resources to ensure regulatory compliance and to preserve, protect, and manage those resources. Ecological monitoring is an integral aspect of determining whether the management objectives and goals for the natural resources at the Site are being achieved. This report summarizes the results of the ecological monitoring that was conducted at the Site during 2006.

At an elevation of approximately 6,000 feet, the Site contains a unique ecotonal mixture of mountain and prairie plant species resulting from the topography of the area and its proximity to the mountain front. The POU (formerly known as the BZ), the area surrounding COU (the general area where the old IA was once located), is one of the largest remaining undeveloped tracts of its kind along the Colorado Piedmont. A number of plant communities present at the Site have been identified as increasingly rare and unique by the Colorado Natural Heritage Program (CNHP; CNHP 1994, 1995). These communities include the xeric tallgrass prairie, tall upland shrubland, wetlands, and Great Plains riparian woodland communities. Small inclusions of a number of other increasingly rare plant communities are also found on the Site. Many of these communities support populations of increasingly rare animals as well, including the federally protected Preble's meadow jumping mouse, and other uncommon species such as the grasshopper sparrow, loggerhead shrike, Merriam's shrew, black crowned night heron, hops blue butterfly, and Arogos skipper.

A brief summary of the highlights from the 2006 field season is found below. Full detailed summaries and analyses for each field monitoring effort are presented as stand-alone reports on the accompanying Ecology CD-ROM.

6.2 Vegetation Monitoring

6.2.1 High Value Vegetation Monitoring

The Site is located along the Front Range of Colorado in an ecotonal position between the Great Plains and Rocky Mountains. As a result it contains plant species common to both physiographic regions. Several plant communities have been identified by the CNHP as containing significant or rare ecological resources at both the local and regional scale (CNHP 1994, 1995). These high-value plant communities (xeric tallgrass prairie, tall upland shrubland, selected wetlands, and Great Plains riparian woodland) are monitored to assess their status and condition.

Objectives of the high-value vegetation monitoring in 2006 were to qualitatively:

- Identify new plant records found at the Site during the field season.
- Evaluate the populations of known rare plants at the Site,
- Identify and document infestations of selected noxious weeds,
- Document the locations where herbicide applications were conducted.

6.2.1.1 Site Flora

The complete list of plant species known to occur at the Site as of the end of 2006 is found in Appendix A on the CD-ROMs. As a result of the 2006 fieldwork, a total of four new records of vascular plant species for the Site flora are reported. None of these species are noxious weeds. Many were found growing in newly revegetated areas. The new plant species[39] occurring at the Site are described in Table 6−1.

Table 6−1. New Plant Species at Rocky Flats

Family	Scientific Name	Speccode	Common Name
Poaceae	*Leptochloa fasicularis* (Lam.) A. Gray	LEFA1	Bearded Sprangletop
Juncaginaceae	*Triglochin maritima* L.	TRMA1	Arrowgrass
Caryophyllaceae	*Spurgularia media* (L.) Presl.	SPME1	Sand Spurrey
Poaceae	*Chloris virgata* Sw.	CHVI2	Showy Chloris

Voucher specimens of these species will be deposited at the University of Colorado Herbarium in Boulder, Colorado.

6.2.1.2 Rare-Plant Monitoring

Four plant species that occur at the Site are listed as rare and imperiled in Colorado by CNHP (CNHP 1999). The presence of these species underscores the significance of the ecological resources found at the Site and its value in the regional landscape. Populations of mountain-loving sedge (*Carex oreocharis*), forktip three-awn (*Aristida basiramea*), carrionflower greenbriar (*Smilax herbacea* ssp. *lasioneuron*), and dwarf wild indigo (*Amorpha nana*) are known to occur at the Site.

Populations of all four species were visited during 2006 and qualitative observations were made of each species. The carrionflower greenbriar was less abundant in 2006 than past observations have recorded, most likely due to the drought. The species occurs in isolated patches beneath the tall upland shrublands in the main branch of Rock Creek and requires abundant moisture. Old stems from previous years and a few new stems from 2006 (one male plant was in flower) were observed. The lack of moisture probably accounts for the fewer stems observed in 2006, since nothing else has occurred at these locations that might have had an impact on it.

The dwarf wild indigo continues to consist of a single small shrub in the Rock Creek drainage. The plant was observed as it was leafing out and prior to flowering in 2006. A total of 10 stems were counted coming up from the base. It appears to continue to do well in its isolated location in Rock Creek as the only population known at the Site.

Mountain loving sedge occurs predominantly along the north edges of the pediment tops in the Rock Creek drainage. At one location, the herbicide Plateau® had been applied in the area for control of jointed goatgrass (*Aegilops cylindrica*) in 2005 and there was some minor effects

[39] Plant nomenclature follows that of GPFA (1986), Weber (1976), and Weber (1990), in that order of determination when feasible. Species were verified at the University of Colorado Herbarium in Boulder, Colorado (COLO).

observed on the plants in 2006 (small amount of chlorosis on leaf tips). But the plants had flowered and otherwise appeared unaffected by the management actions. Because Plateau® is used for control of some monocot (graminoid) species at the Site it is worth noting this effect and future weed control efforts should minimize the use of this herbicide where this sedge species is present. Other populations outside where the herbicide had been applied appeared to be doing well and many of these had flowered in 2006.

Forktip three-awn was observed at several locations at the Site in late fall 2006. The drought in 2006 had apparently reduced the overall abundance to some degree and fewer plants appeared to have flowered. But given that the plant is an annual, it is not unexpected to see such a response to drought. Other annual plants observed on the prairie at the Site responded in a similar fashion in 2006.

The annual plant counts of the forktip three-awn were continued in 2006 at the locations where seeding of forktip three-awn was done in the south POU in 2001 and 2002. In fall 2001, seed collected from the original known location of forktip three-awn at the Site was sown by hand into two 1 meter square plots (approximately 100 seeds per plot). During 2002, additional seed (approximately 400 seeds) was collected at large new population discovered along North Walnut Creek, west of the COU in 2001. This seed was sown in four 1 meter square plots near where the seeding trials had been conducted in 2001. Approximately 100 seeds were placed in each plot in fall 2002. Table 6−2 shows the number of plants that have been counted annually, in and adjacent to the plots since the project was begun. In 2006, a large decrease in the number of plants in the plots was observed, most likely due to the drought conditions. It is expected that when normal precipitation returns the abundance of the plants in the plots will increase again. In general however, the seeding study has shown that the species germinates and grows readily under Site conditions that mimic where it has been found growing naturally at the Site.

Table 6−2. Forktip Three-Awn Establishment Summary

Year	Plot						Total #	Precipitation (in)
	2001-NW	2001-SE	2002-1	2002-2	2002-3	2002-4		
2002	25	28	NA	NA	NA	NA	53	7.85
2003	15	28	85	20	15	27	190	11.95
2004	7	54	136	13	21	34	265	18.71
2005	13	98	198	18	30	33	390	13.51
2006	3	8	15	0	0	9	35	6

Notes: Values are the number of plants that had germinated and grown during that year.
Plot name = Year - Plot ID
Precipitation data = March to September for each year.

6.2.1.3 Weed Mapping and Weed Control

Resource management is an important concern at the Site with a goal to protect and sustain the native ecological resources that make the Site so unique along the Front Range. One of the challenges at the Site is to manage the ecological resources with a limited set of methods available as management tools. Currently most efforts focus on the control or eradication of the weed species themselves with little emphasis on trying to improve conditions for the desired native species. Two of the key tools for grassland management, fire and grazing, are not

currently allowed or planned for use at the Site in the near future. As a result, management of the ecological resources is largely limited to controlling the noxious weeds themselves. The Comprehensive Conservation Plan (USFWS 2005) developed by the U.S. Fish and Wildlife Service (USFWS) for management of the Rocky Flats National Wildlife Refuge, has identified the full range of Integrated Pest Management tools for use at the refuge for controlling weeds. This includes administrative, cultural, biological (including grazing), mechanical (including prescribed fire), and chemical as viable tools for controlling noxious weeds and ecosystem management. As part of the Site transfers to USFWS in 2007, there may be a greater opportunity for some of these other resource management tools to be used.

As part of the data collection needed for good stewardship of the natural resources at the Site, mapped locations of noxious weeds are useful for helping to determine where control actions may be needed. The 2006 weed distribution maps for diffuse knapweed (*Centaurea diffusa*) and dalmatian toadflax (*Linaria dalmatica*) are shown in Figure 6–1 and Figure 6–2, respectively. Table 6−3 contains the estimated total acreage and acreage-by-density categories for each species, based on the 2006 maps. Table 6−4 shows the annual total infested acreages for diffuse knapweed and dalmatian toadflax from 1997 to 2006. [NOTE: Most of the large increases in infestation acreages from 1997 to 1998 were a result of the time of year in which mapping was conducted. Mapping in 1997 was conducted in August for each of the species. Beginning in 1998, weed mapping was conducted for each species when that species was in flower and/or most visible. Therefore, the higher visibility of the species at the time of mapping allowed more accurate estimates of their infestation levels from 1998 through 2006.] The total acreage of the Site is approximately 6,500 acres (K-H 1997). It should be noted that the acreage values are only approximate and should not be interpreted as exact areas. It is possible that unmapped infestations are present as well.

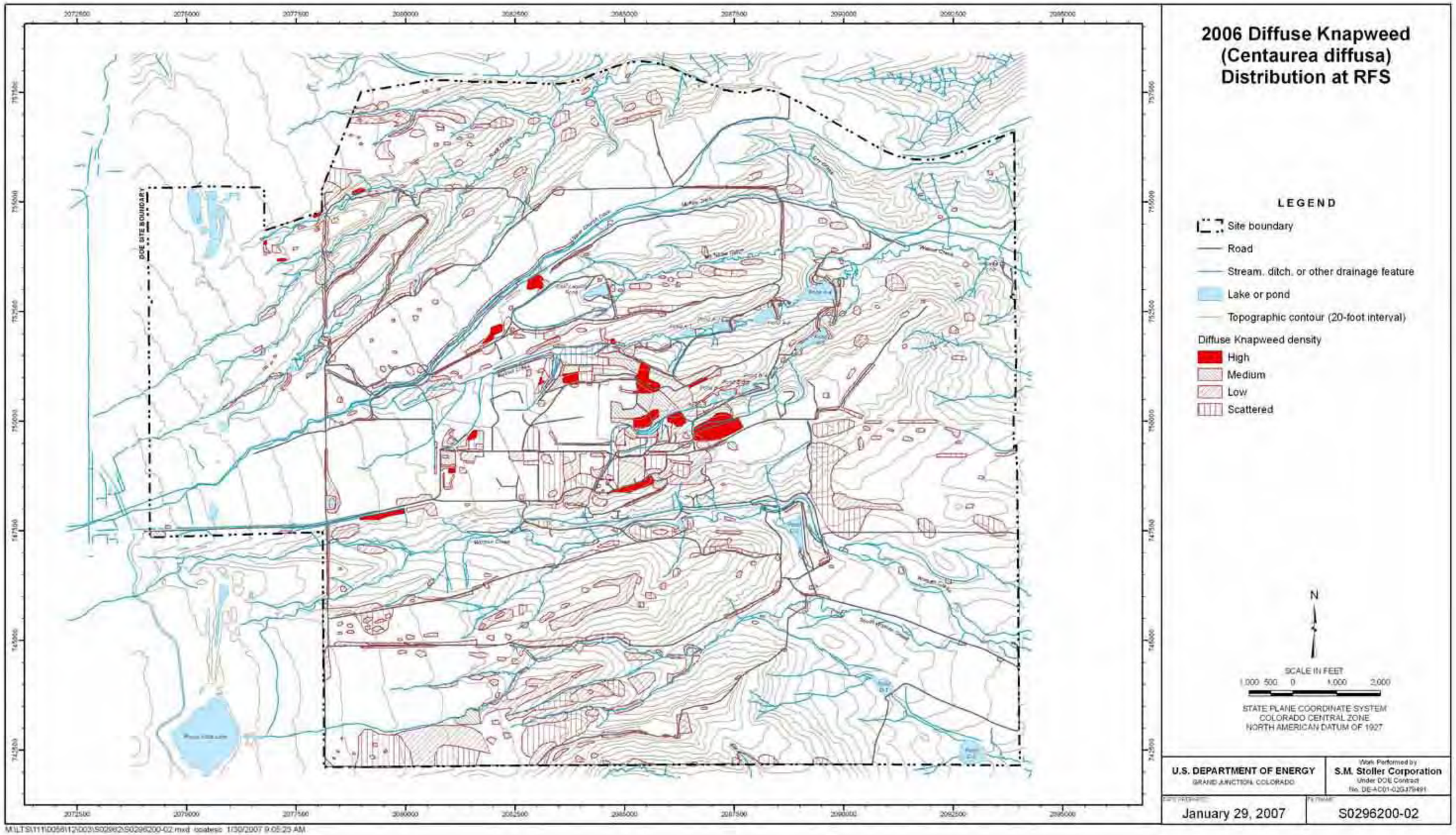


*Figure 6–1. 2006 Diffuse Knapweed (*Centaurea diffusa*) Distribution at RFS*

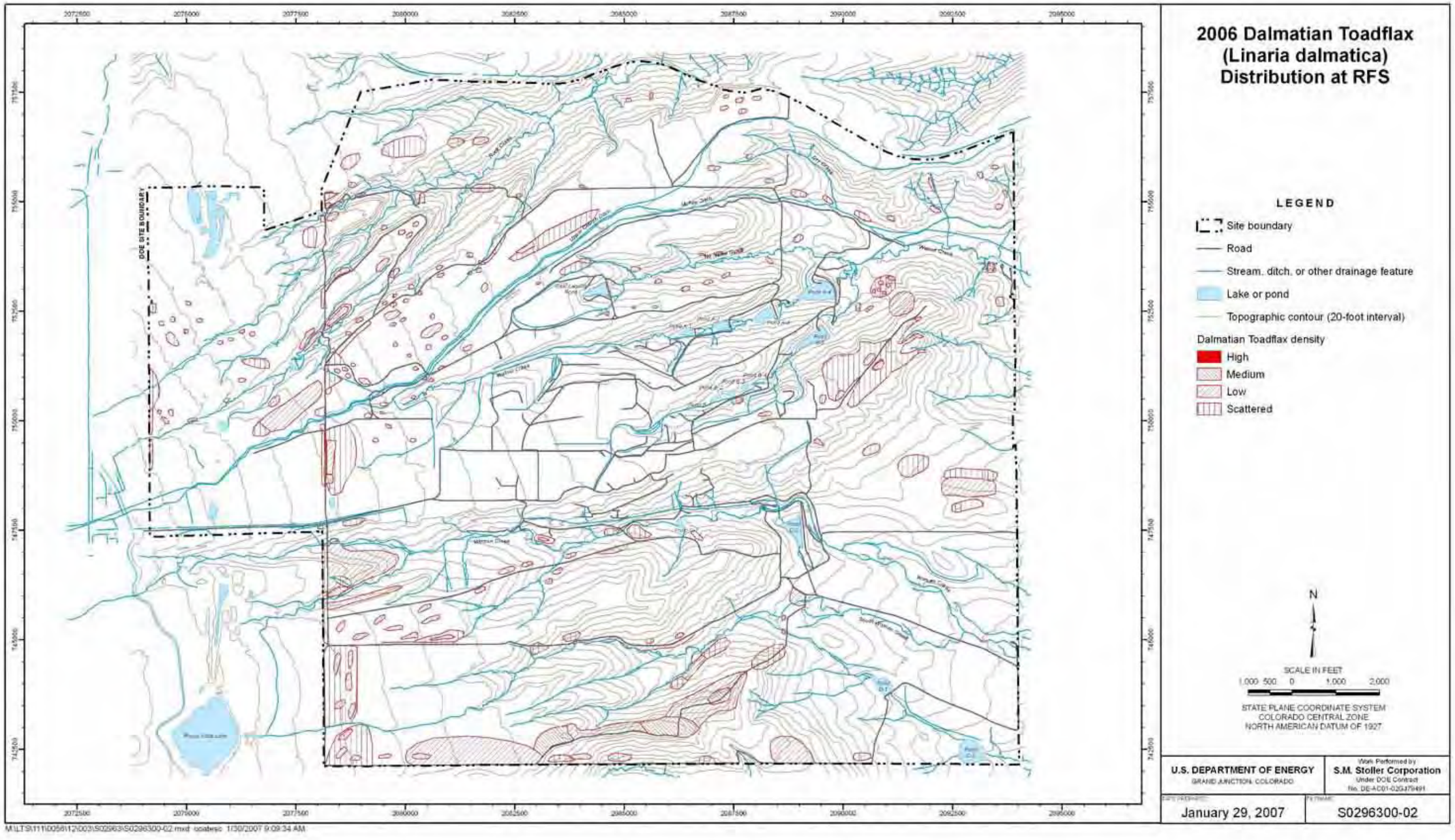


*Figure 6–2. 2006 Dalmatian Toadflax (*Linaria dalmatica*) Distribution at RFS*

Table 6−3. 2006 Estimated Weed Infestation Acreage Summary for the Rocky Flats Site

	2006 Acreage				
	Site Total	Density Level			
Common Name		High	Medium	Low	Scattered
Diffuse Knapweed	800	38	95	367	300
Dalmatian Toadflax	467	0	25	193	249

Notes: All values are approximate acreages.
See text for density level descriptions.

Table 6−4. Comparison of 1997−2006 Weed Infestation Extents at the Rocky Flats Site

Weed Species	Year	Site Total	Density Level			
			High	Medium	Low	Scattered
Diffuse Knapweed	1997	2678	696	893	658	431
	1998	2913	761	778	987	388
	1999	2295	466	613	873	343
	2000	2223	510	531	771	412
	2001	1957	381	525	674	377
	2002	1093	165	344	368	215
	2003	2127	182	512	857	576
	2004[a]	2259	77	390	1187	605
	2005[a]	2158	29	296	902	931
	2006[a]	800	38	95	367	300
Dalmatian Toadflax	1997	422	135	205	82	0
	1998	1934	313	273	989	359
	1999	2507	341	389	1240	537
	2002	1264	5	69	281	909
	2003	2897	109	388	1563	837
	2004	2858	77	450	1559	772
	2005[a]	3085	24	169	1400	1492
	2006[a]	467	0	25	193	249

[a]Acreages do not include Centennial Mine area as it has in previous years. It was not mapped due to the expansion of the mine and/or lack of access and visibility of the mine area.
Notes: All values are approximate acreages.
See text for density level descriptions.

In 2006, diffuse knapweed was observed on approximately 800 acres at various levels of infestation. This is down considerably from previous years that have averaged 2,000+ acres per year. Dalmatian toadflax was mapped on approximately 467 acres at the Site in 2006. This is huge decrease from the 3,085 acres present in 2005. Considerable annual variation in the number of infested acres for each species listed in Table 6−4 exists due to annual climatic differences and past herbicide applications. Most of the reductions for each species from 1998 or 1999 through 2002 were due to the large-scale aerial herbicide applications. In 2002, some of the decreases seen for each species were also a result of the drought that year. That drought caused many species, native species and noxious weeds alike, to either remain dormant or to not germinate that year. However, in 2003 there was a large increase in the number of infested acres due to the above average snowfall received in March 2003 that caused a large germination of annual species' seed from the seedbank and growth of dormant perennial plants. This resulted in nearly

twice the number of acres infested with diffuse knapweed and dalmatian toadflax in 2003 compared to 2002. Increased precipitation in 2004 and 2005 also probably accounts for the continued high number of infested acres in 2004. The huge decline in the abundance of both of these species in 2006 is likely due to the drought conditions experienced at the Site throughout the winter, spring, and summer of 2006. Many other species at the Site remained dormant and/or did not germinate in 2006.

During 2006, a total of approximately 401 acres were treated with herbicides using ground applications. Figure 6–3 and Figure 6–4 show the locations where herbicide applications were made in 2006. Table 6−5 lists the herbicides and application rates applied at each location. [Note: At several locations multiple herbicides are listed for a location. This does not mean that each herbicide was used across that entire location. Rather depending on site-specific characteristics (target weed species, the locations of water bodies, soil types, and the professional judgment of the licensed herbicide applicator), different herbicides were used within that location to provide the control needed.] Locations (GIS Ref ID column in Table 6−5) up to number 67 were treated in the spring and early summer of 2006, while the locations from number 68 and upward were treated in the fall. The fall applications were made to control the rosettes that were already present for some species and as a pre-emergent application for other species. In previous years herbicide applications have not been made in Preble's mouse habitat because of restrictions placed on the Site by USFWS. A document was prepared and consultation was conducted with USFWS on the use of herbicide applications for weed control in Preble's mouse habitat during the winter/spring of 2005/2006. Approval for the use of selected herbicides in Preble's mouse habitat was received in April 2006. Several locations in Preble's habitat were targeted for applications to control such species as Dame's rocket (*Hesperis matronalis*), Canada thistle (*Cirsium arvense*), and diffuse knapweed.

A new herbicide that became available in 2006, Milestone (active ingredient = aminopyralid), was used to treat several areas at the Site. The low application rate, low environmental impact status, and yet high effectiveness on many species we have at the Site has made this herbicide a very good tool in our toolbox. The fact that it can be sprayed to the waters edge also makes this a good tool for controlling Canada thistle and other weedy species that are often common around the ponds and wetland edges. Previously near water these species have been much more difficult, if not impossible to control with other methods. Observations of the treated areas in 2006 have shown that the Milestone has done a very good job in controlling the species that were targeted with it.

The effectiveness of biocontrol insects that have been released at the Site continues to be monitored. The results from the biocontrol study on diffuse knapweed are reported in another section of the annual report. Additional biocontrols will be released as they become available. Collections from established populations at the Site will be made and moved to other infestations at the Site where control is needed, as feasible.

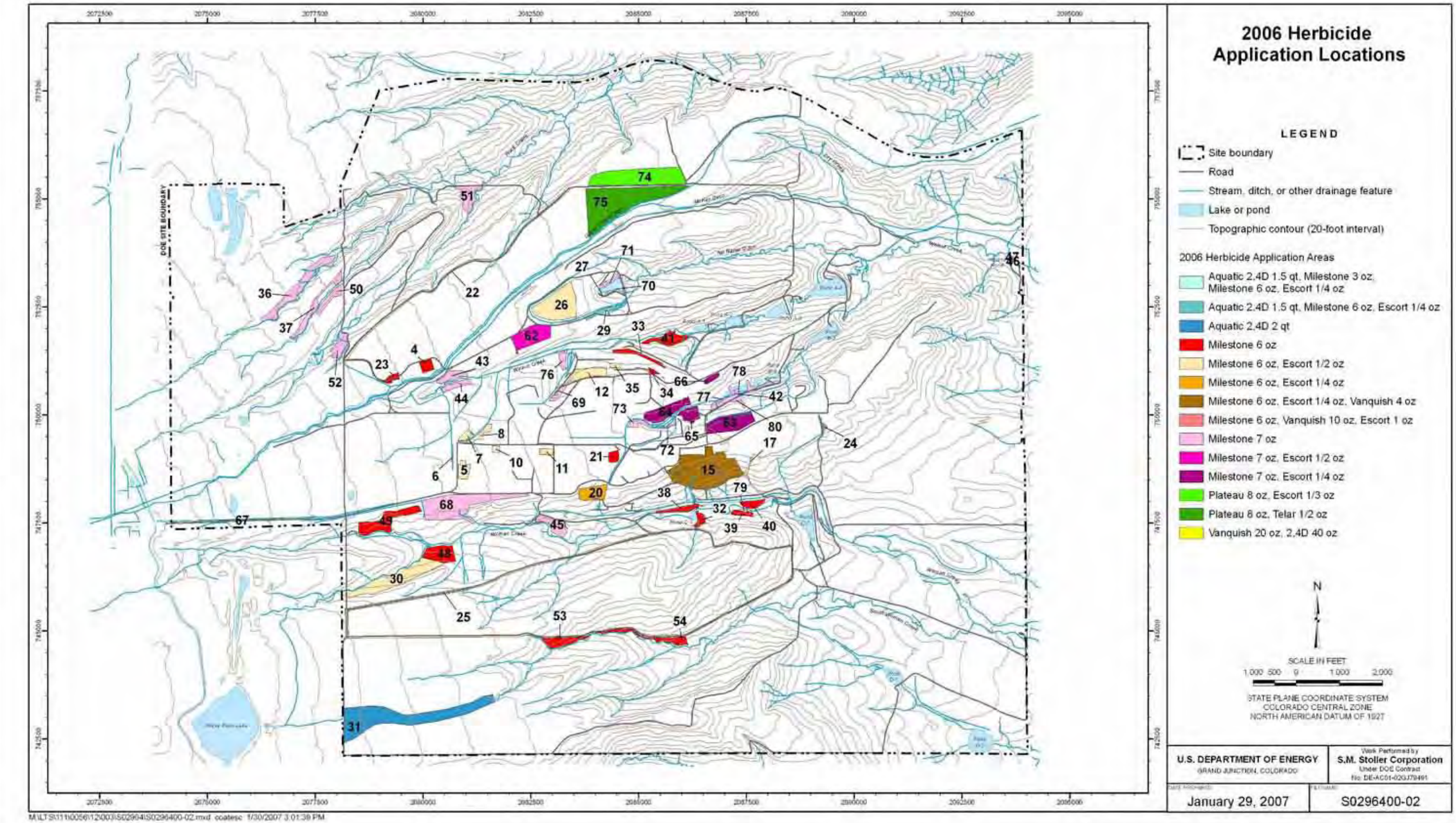


Figure 6–3. 2006 Herbicide Application Locations

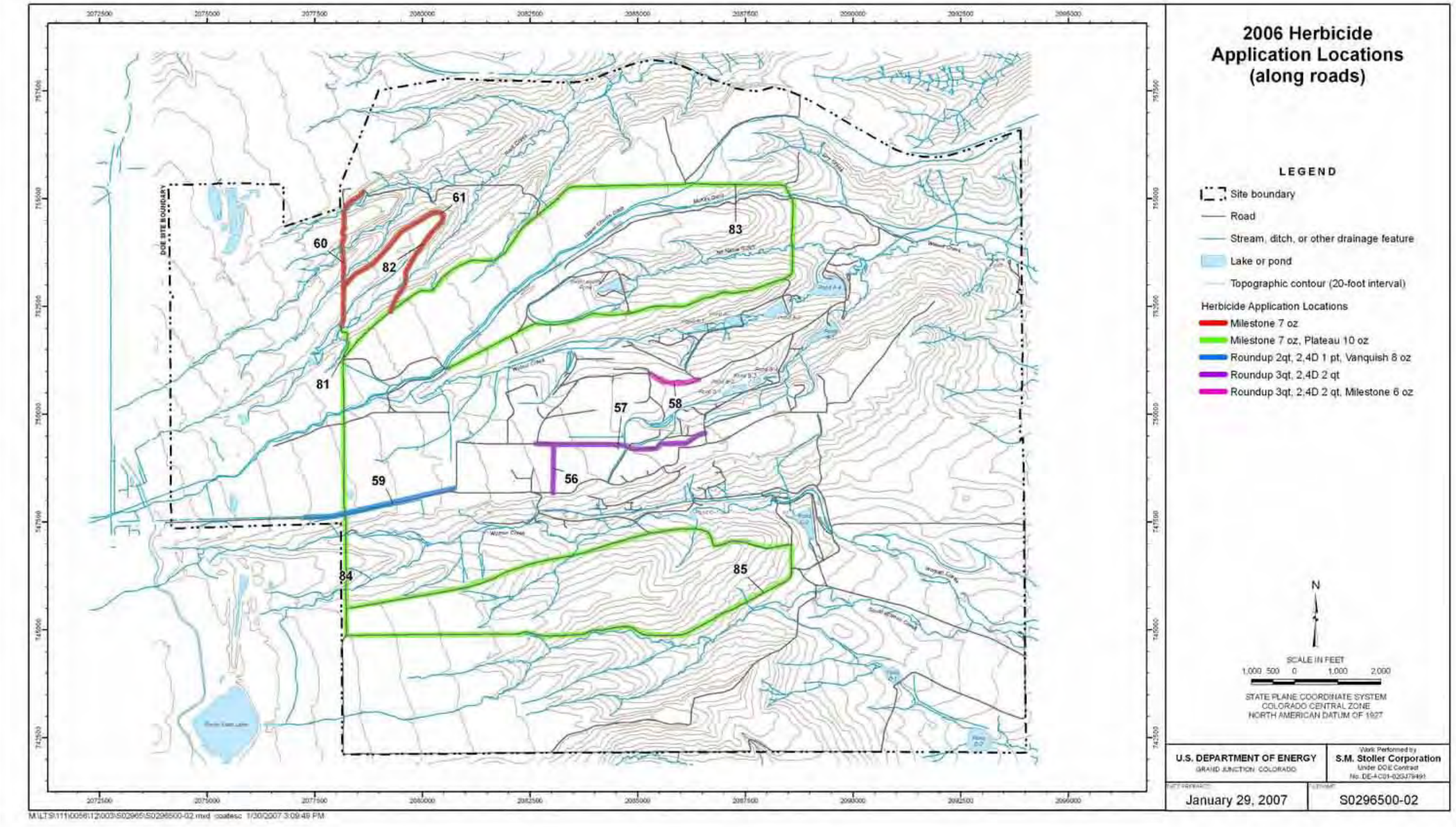


Figure 6–4. 2006 Herbicide Application Locations (along roads)

Table 6−5. 2006 Weed Control Location Summary

GIS Ref ID	Acres Treated	Herbicide/Application Rate	Application Method
4	1.70	Milestone 6 oz	ATV
5	2.20	Milestone 6 oz, Escort 1/2 oz	ATV
6	0.25	Milestone 6 oz, Escort 1/2 oz	ATV
7	1.20	Milestone 6 oz, Escort 1/2 oz	ATV
8	1.70	Milestone 6 oz, Escort 1/2 oz	ATV
10	0.50	Milestone 6 oz, Escort 1/2 oz	ATV
11	1.00	Milestone 6 oz, Escort 1/2 oz	ATV
12	5.00	Milestone 6 oz, Escort 1/2 oz	ATV
15	28.00	Milestone 6 oz, Escort 1/4 oz, Vanquish 4 oz	ATV
17	1.00	Milestone 6 oz, Escort 1/2 oz	ATV
20	4.00	Milestone 6 oz, Escort 1/4 oz	ATV
21	1.25	Milestone 6 oz	ATV
22	10.00	Milestone 6 oz, Escort 1/2 oz	Truck
23	2.00	Milestone 6 oz	ATV
24	0.40	Milestone 6 oz, Vanquish 10 oz, Escort 1 oz	ATV
25	23.00	Milestone 6 oz, Escort 1/2 oz	Truck
26	12.00	Milestone 6 oz, Escort 1/2 oz	ATV
27	2.25	Aquatic 2,4D 1.5 qt, Milestone 3 oz, Milestone 6 oz, Escort 1/4 oz	ATV
29	3.00	Aquatic 2,4D 2 qt, Milestone 6 oz, Escort 1/4 oz	ATV
30	11.50	Milestone 6 oz, Escort 1/2 oz	ATV
31	24.00	Aquatic 2,4D 2 qt	ATV
32	1.50	Milestone 6 oz	ATV
33	3.00	Milestone 6 oz	ATV
34	1.00	Milestone 6 oz	ATV
35	1.50	Milestone 6 oz, Escort 1/2 oz	ATV
36	6.00	Milestone 7 oz	ATV
37	4.00	Milestone 7 oz	ATV
38	2.75	Milestone 6 oz	ATV
39	1.25	Milestone 6 oz	ATV
40	2.00	Milestone 6 oz	ATV
41	5.00	Milestone 6 oz	ATV
42	5.00	Milestone 7 oz	ATV
43	3.25	Milestone 7 oz	ATV
44	2.50	Milestone 7 oz	ATV
45	4.00	Milestone 7 oz	ATV
46	0.30	Milestone 7 oz	ATV
47	0.20	Milestone 7 oz	ATV
48	5.50	Milestone 6 oz	ATV
49	8.50	Milestone 6 oz	ATV
50	2.50	Milestone 7 oz	ATV
51	4.75	Milestone 7 oz	ATV
52	3.50	Milestone 7 oz	ATV
53	4.00	Milestone 6 oz	ATV
54	4.00	Milestone 6 oz	ATV
56	0.50	Roundup 3 qt, 2,4D 2 qt	ATV
57	1.50	Roundup 3 qt, 2,4D 2 qt	ATV
58	0.50	Roundup 3 qt, 2,4D 2 qt, Milestone 6 oz	ATV

Table 6−5 (continued). 2006 Weed Control Location Summary

GIS Ref ID	Acres Treated	Herbicide/Application Rate	Application Method
59	3.50	Roundup 2 qt, 2,4D 1 pt, Vanquish 8 oz	ATV
60	3.25	Milestone 7 oz	ATV
61	5.75	Milestone 7 oz	ATV
62	9.00	Milestone 7 oz, Escort 1/2 oz	ATV
63	9.00	Milestone 7 oz, Escort 1/4 oz	ATV
64	7.50	Milestone 7 oz, Escort 1/4 oz	ATV
65	3.00	Milestone 7 oz, Escort 1/4 oz	ATV
66	1.00	Milestone 7 oz, Escort 1/4 oz	ATV
67	3.00	Vanquish 20 oz, 2,4D 40 oz	ATV
68	17.00	Milestone 7 oz	ATV, Backpack
69	1.50	Milestone 7 oz	ATV
70	1.50	Milestone 7 oz	ATV, Backpack
71	1.00	Milestone 7 oz	ATV, Backpack
72	1.00	Milestone 7 oz	ATV
73	1.50	Milestone 7 oz	ATV
74	18.00	Plateau 8 oz, Escort 1/3 oz	ATV
75	27.00	Plateau 8 oz, Telar 1/2 oz	ATV
76	2.00	Milestone 7 oz	ATV
77	0.75	Milestone 7 oz	ATV
78	0.75	Milestone 7 oz	ATV
79	0.25	Milestone 7 oz	ATV
80	2.50	Milestone 7 oz	ATV
81	9.00	Milestone 7 oz, Plateau 10 oz	Truck
82	8.50	Milestone 7 oz, Plateau 10 oz	Truck
83	22.00	Milestone 7 oz, Plateau 10 oz	Truck
84	4.50	Milestone 7 oz, Plateau 10 oz	Truck
85	23.00	Milestone 7 oz, Plateau 10 oz	Truck
Total Acres Sprayed in 2006	401.20		

Note: At several locations multiple herbicides are listed for a location. This does not mean that each herbicide was used across that entire location. Rather depending on site-specific characteristics (target weed species, the locations of water bodies, soil types, and the professional judgment of the licensed herbicide applicator), different herbicides were used within that location to provide the control needed.

6.2.2 Dalmatian Toadflax Monitoring

Dalmatian toadflax is a noxious weed that has invaded hundreds of acres across the Site and is a problem throughout much of the Front Range of Colorado. The species is an escaped ornamental plant from Europe. Dalmatian toadflax is listed as a List “B” species under the Colorado Noxious Weed Act (CNWA 2006). This means it is established in the state and statewide eradication is not possible. The species is well adapted to arid environments and has a deep, extensive root system. The deep root system, waxy leaves, and high seed production make the species difficult to control. The species is a significant problem for ecological resource management because of its ability to replace native plant species and degrade the quality of the land for wildlife or grazing.

A three-phase study was conducted to evaluate the effectiveness of Tordon 22K® alone (applied at two different application rates [1 pint/acre and 1 quart/acre]) and Tordon 22K® (1 quart/acre) plus Telar® (1 ounce/acre) on dalmatian toadflax density. The study was conducted using a control plot and treatment plots. The three phases were initiated over a three year period while the same control plot was used for all three phases.

From 2003 through 2005, dalmatian toadflax density in the control plot increased from 75.2 stems per square meter (stems/m^2) to 126.1 stems/m^2 (Figure 6–5). Some of the increase may have been due to the above average precipitation received in 2004 and 2005 (November to June precipitation; average [1992−2005] = 10.24 inches, 2004 = 13.08 inches, 2005 = 12.58 inches). In 2006, dalmatian toadflax density in the control plot dropped to only 56.5 stems/m^2 (Figure 6–5). This was likely in response to the below average precipitation received (November to June precipitation; 2006 = 4.98 inches).

In the Phase I study, looking at the effect of an application of 1 pint of Tordon 22K®/acre, dalmatian toadflax densities dropped annually from 72 stems/m^2 in 2003 to 28.4 stems/m^2 in 2005 (Figure 6–5). In 2006, the continued effect of the herbicide, plus the drought resulted in only 7.2 stems/m^2. In the Phase II study, dalmatian toadflax densities dropped from 64.8 stems/m^2 in 2004 to 23.7 stems/m^2 in 2005 in response to a single application of Tordon 22K® at 1 quart/acre (Figure 6–5). In 2006, the continued effect of the herbicide, plus the drought resulted in only 12.1 stems/m^2. In the Phase III study, dalmatian toadflax densities dropped from 117.0 stems/m^2 in 2005 to only 9.9 stems/m^2 in 2006.

Excluding the 2006 drought effects, both the Phase I and Phase II studies (2003−2005 data) have shown that the herbicide applications have had a substantial impact on dalmatian toadflax density. Stem densities were reduced by 61 percent and 63 percent in the Phase I and Phase II studies, respectively, while densities continued to increase during the same timeframe in the control plot (increase of 68 percent). In 2006, adding in the effect of the drought, plus the residual herbicide effects, the dalmatian toadflax densities have been reduced by 90 percent and 81 percent in the Phase I and Phase II studies, respectively. In the Phase III study, the herbicide effects plus drought effects have reduced the dalmatian toadflax density by more than 91 percent in a single year. Based on this information alone and given the small differences in results between the different treatments, a single application of Tordon 22K® at a rate of 1 pint per acre is just as effective as the higher application rates of the other two treatments. It is also evident that drought has a substantial effect on dalmatian toadflax density. The effect of the drought alone on the control plot reduced dalmatian toadflax density from 126.1 stems/m^2 in 2005 to 56.5 stems/m^2 in 2006 (a reduction of 55 percent).

Although the drought complicates the interpretation of the results, because the drought alone also reduces dalmatian toadflax densities, the fact that the drought occurred across all three treatments equally, at least somewhat negates its effect. A different analysis was done to try and take into account the effect of the drought on the study results. If 55 percent of the dalmatian toadflax density reduction from 2005 to 2006 is attributable to the drought (based on the control), then only 20 percent or 5.7 stems/m^2 of the stem reduction at the Phase I study from 2005−2006 is attributable to the continued effect of the herbicide. This amount combined with the reductions that occurred from 2003 to 2005, means a reduction from 72 stems/ m^2 in 2003 to 22.7 stems/m^2 in 2006 (68 percent reduction in stem density) is attributable to the herbicide effects at the Phase I study. Thus the application of 1 pint of Tordon 22K® per acre reduced dalmatian toadflax

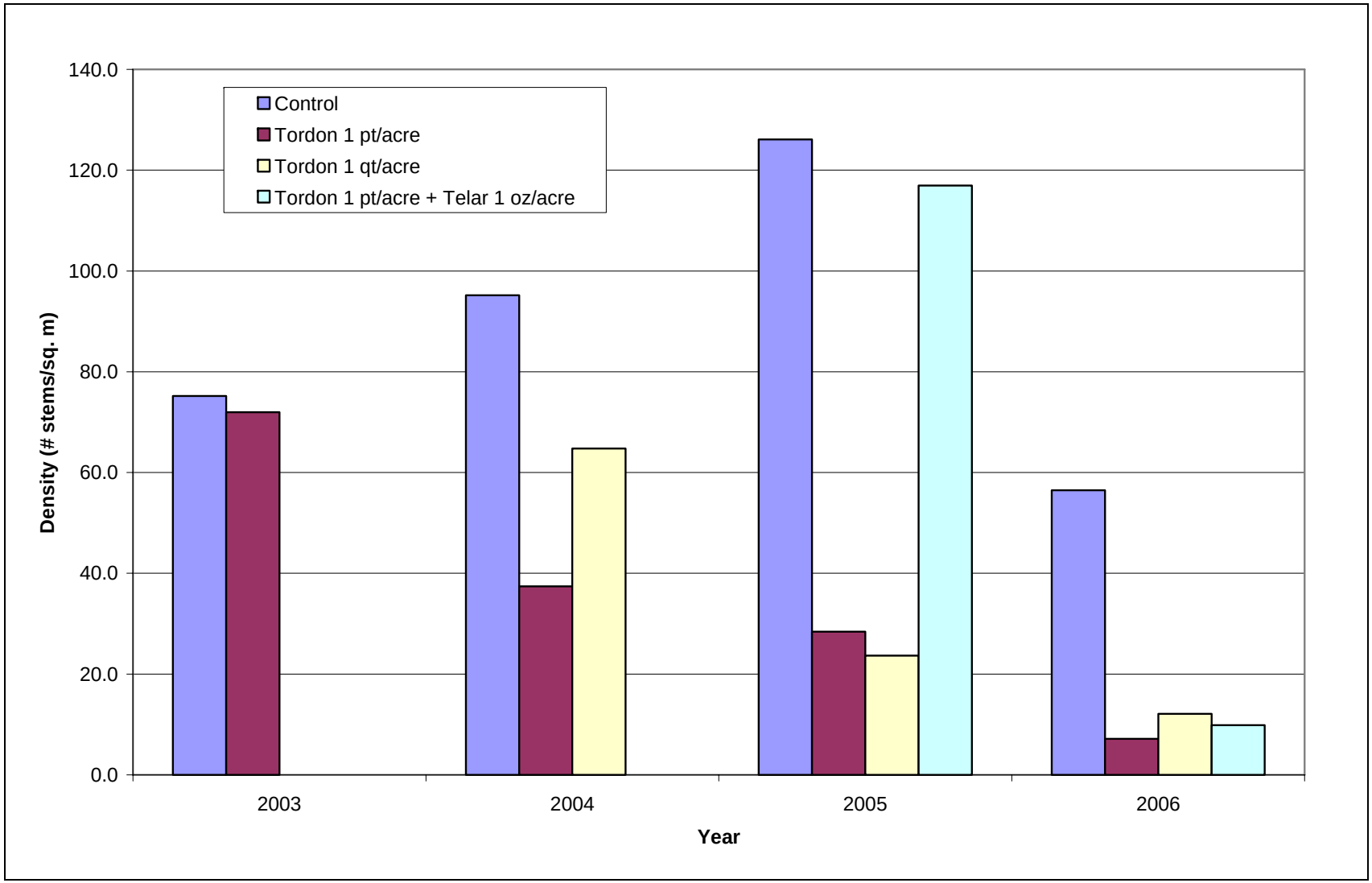


Figure 6–5. Dalmatian Toadflax Stem Density Response to Herbicide Applications

density by 68 percent. At the Phase II study, none of the reduction in stem density from 2005−2006 was attributable to the herbicide because the percentage change at the Phase II locations was less than 55 percent during this time frame. Thus an overall stem density reduction of 63 percent is attributable to an application of 1 quart of Tordon 22K® for the Phase II study. For the Phase III study, if the 55 percent reduction in stem density attributable to drought is removed, only 36 percent or 42 stems/m^2 of the stem density reduction observed in 2006 is attributable to the herbicide application of Tordon 22K® plus Telar®. Based on this analysis, it is apparent that a single application of Tordon 22K® at a rate of 1 pint per acre is more effective at reducing dalmatian toadflax density than the other two treatments. This would also be more cost effective and have less potential environmental side-effects.

The final conclusion is that using either type of data analysis, the results are the same. A single application of Tordon 22K® at a rate of 1 pint per acre just as effective at reducing dalmatian toadflax density as the other two treatments.

6.2.3 Revegetation Monitoring

As part of the cleanup and closure of the Site, the buildings, roads, and other infrastructure in the COU were removed. Approximately 650 acres were disturbed during cleanup activities that were completed in fall 2005. Revegetation of the disturbed areas was conducted to prevent erosion and sedimentation of the Site streams and to meet water quality standards. Re-establishment of native plant species is desirable to benefit wildlife and the future of the Site as a National Wildlife Refuge. As part of the revegetation process, monitoring is conducted to determine whether success criteria, as stated in the Revegetation Plan (DOE 2005c) are being met as well as to determine whether management of these resources are needed. The objective of the revegetation monitoring in 2006 was to assess the status of the revegetation efforts at selected locations.

Semi-quantitative revegetation monitoring was conducted during summer in 2006 to evaluate the establishment of vegetation at revegetation locations across the Site. The monitoring methodology provided in the Revegetation Plan was used with some modification. The revegetation areas were divided into “units” or areas based on geographic features (i.e., roads, streams) or previous building areas (i.e., 700 Area, 400 Area). A total of 25 revegetation units were sampled (Figure 6–6). Within each revegetation unit, sample locations were randomly generated in the GIS and then located on the ground using a global positioning system (GPS) for monitoring. Quadrats (0.5 m^2; 50 cm × 100 cm) were used to sample the vegetation. Dependent on the size of the area, the number of quadrats sampled in each area varied from 10 to 30 quadrats. A total of 480 quadrats were sampled in 2006. Table 6−6 lists the number of quadrats sampled in each unit. At each quadrat, both species richness and species cover were sampled.

Table 6−6. 2006 Revegetation Location Sample Sizes

Location	Number of Quadrats Sampled
A1	30
A2	30
A3	10
A4	30
A5	30
A6	10
A7	30
A8	10
A9	30
A10	10
A11	30
A12	30
A13	10
A14	10
A15	15
A16	10
A17	10
A18	10
A19	15
A20	10
A21	30
A22	30
A23	10
A24	10
A25	30
Total	480

Species richness across all sampled revegetation units is presented in Table 6−7. Species richness in 2006 at the revegetation units ranged from a low of nine species in unit A10 to 39 species at unit A22. The wide range of in the number of species present in each revegetation unit is attributable to a number of factors including: how long ago the area was revegetated, the size of the unit, the number of quadrats sampled in the unit, and what management actions (i.e., weed control) have been conducted in the area. A total of 13 seeded graminoid species had established and were growing at some or all locations in 2006 (shaded rows in Table 6−7). Two species, western wheatgrass (*Agropyron smithii*) and slender wheatgrass (*Agropyron caninum* = *Agropyron trachycaulum*) were established at all 25 locations. As would be expected in a revegetation project many other early successional species were growing at most of the areas. Kochia (*Kochia scoparia*), Russian thistle (*Salsola iberica*), wild lettuce (*Lactuca serriola*), yellow sweet clover (*Melilotus officinalis*), and hoary vervain (*Verbena bracteata*) were among the more common. These will largely disappear on their own over the next couple of years as the seeded species begin to fill in more. Several noxious weeds also occurred in the revegetation areas. The most common of these were diffuse knapweed, fillaree (*Eurodium cicutarium*), and downy brome (*Bromus tectorum*). Weed management will be conducted as needed to keep noxious weed populations down in the revegetation areas, so that the desired seeded species can establish more quickly and help compete with the weeds.

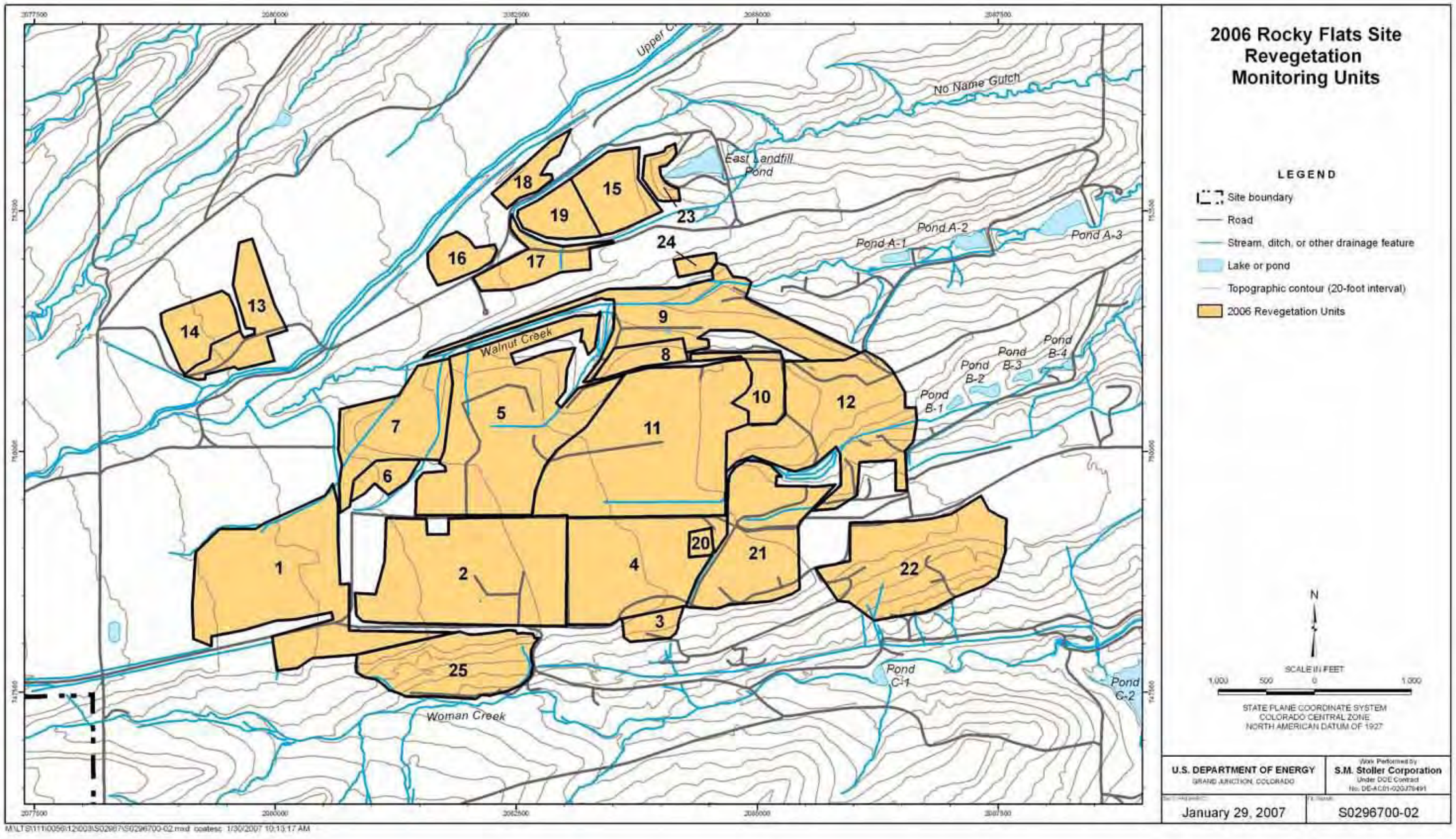


Figure 6–6. 2006 Rocky Flats Site Revegetation Monitoring Units

Table 6−7. Species Richness Summary at Locations A1−A25

Family	Scientific Name	Speccode	Native	Noxious Weed	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24	A25
AMARANTHACEAE	Amaranthus albus L.	AMAL2	N														X												
ASCLEPIADACEAE	Asclepias speciosa Torr.	ASSP1	Y																							X			
ASTERACEAE	Ambrosia artemisiifolia L.	AMAR1	Y		X			X													X	X			X				
ASTERACEAE	Ambrosia psilostachya DC.	AMPS1	Y										X		X						X			X	X	X	X		
ASTERACEAE	Artemisia campestris L. ssp. caudata (Michx.) Hall & Clem.	ARCA1	Y																	X				X					
ASTERACEAE	Artemisia frigida Willd.	ARFR1	Y																					X					
ASTERACEAE	Aster porteri Gray	ASPO1	Y									X							X										
ASTERACEAE	Carduus nutans L. ssp. macrolepis (Peterm.) Kazmi	CANU1	N	X				X								X										X			
ASTERACEAE	Centaurea diffusa Lam.	CEDI1	N	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X		X
ASTERACEAE	Chrysanthemum leucanthemum L.	CHLE1	N	X																		X							
ASTERACEAE	Chrysopsis fulcrata Greene	CHFU1	Y																							X			
ASTERACEAE	Cirsium arvense (L.) Scop.	CIAR1	N	X				X					X			X									X	X			X
ASTERACEAE	Conyza canadensis (L.) Cronq.	COCA1	Y																X		X						X		
ASTERACEAE	Dyssodia papposa (Vent) Hitchc.	DYPA1	N																	X	X	X							
ASTERACEAE	Erigeron divergens T. & G.	ERDI1	Y																							X			
ASTERACEAE	Grindelia squarrosa (Pursh.) Dun.	GRSQ1	Y		X		X	X				X	X			X			X		X		X	X	X	X	X		
ASTERACEAE	Helianthus annuus L.	HEAN1	Y		X								X			X				X	X				X				
ASTERACEAE	Lactuca serriola L.	LASE1	N		X	X	X	X	X	X		X	X		X	X	X		X	X	X	X	X		X	X	X		X
ASTERACEAE	Liatris punctata Hook.	LIPU1	Y															X											
ASTERACEAE	Scorzonera laciniata L.	SCLA1	N		X																			X	X				
ASTERACEAE	Sonchus arvensis L. ssp. uglinosus (Bieb.) Nyman	SOAR2	N		X				X																				
ASTERACEAE	Taraxacum officinale Weber	TAOF1	N													X			X				X	X					
ASTERACEAE	Thelesperma megapotanicum (Spreng.) O. Ktze.	THME1	Y																					X					
ASTERACEAE	Tragopogon dubius Scop.	TRDU1	N		X			X				X	X			X					X	X	X	X	X	X		X	
BORAGINACEAE	Onosmodium molle Michx. var. occidentale (Mack.) Johnst.	ONMO1	Y																							X			
BRASSICACEAE	Alyssum alyssoides (L.) L.	ALAL1	N																					X	X				
BRASSICACEAE	Alyssum minus (L.) Rothmaler var. micranthus (C. A. Mey.) Dudley	ALMI1	N		X		X	X	X	X		X			X	X	X			X	X			X		X			X
BRASSICACEAE	Erysimum capitatum (Nutt.) DC.	ERCA2	Y								X																		
BRASSICACEAE	Lepidium campestre (L.) R. Br.	LECA1	N		X							X					X		X				X			X		
BRASSICACEAE	Lesquerella montana (A. Gray) Wats.	LEMO1	Y								X																		
BRASSICACEAE	Sisymbrium altissimum L.	SIAL1	N		X																								
CHENOPODIACEAE	Chenopodium album L.	CHAL1	N		X						X						X					X			X				
CHENOPODIACEAE	Chenopodium fremontii S. Wats.	CHFR1	Y		X				X																X				
CHENOPODIACEAE	Chenopodium leptophyllum Nutt. ex Moq.	CHLE2	Y								X																		
CHENOPODIACEAE	Kochia scoparia (L.) Schrad.	KOSC1	N		X	X	X	X	X	X	X		X		X	X	X			X	X				X	X			X
CHENOPODIACEAE	Salsola iberica Senn. & Pau.	SAIB1	N		X	X		X	X		X		X		X	X	X			X	X				X	X			X
CONVOLVULACEAE	Convolvulus arvensis L.	COAR1	N	X	X		X	X		X	X					X						X	X	X	X	X			
EUPHORBIACEAE	Euphorbia serpyllifolia Pers.	EUSE1	Y														X				X	X				X			
FABACEAE	Astragalus canadensis L.	ASCA1	Y					X				X																	
FABACEAE	Medicago lupulina L.	MELU1	N					X																					
FABACEAE	Medicago sativa L. ssp. sativa	MESA1	N													X													
FABACEAE	Melilotus alba Medic.	MEAL1	N							X			X			X							X		X				
FABACEAE	Melilotus officinalis (L.) Pall.	MEOF1	N		X	X	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X	X			X
FABACEAE	Psoralea tenuiflora Pursh.	PSTE1	Y																							X			
GERANIACEAE	Erodium cicutarium (L.) L'Her.	ERCI1	N	X	X	X	X	X	X	X	X				X	X	X			X	X	X	X	X	X	X			X
LAMIACEAE	Marrubium vulgare L.	MAVU1	N													X					X								
LINACEAE	Linum perenne L. var. lewisii (Pursh.) Eat. & Wright	LIPE1	Y																					X		X			

Table 6−7 (continued). Species Richness Summary at Locations A1−A25

Family	Scientific Name	Speccode	Native	Noxious Weed	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24	A25
MALVACEAE	Sphaeralcea coccinea (Pursh.) Rydb.	SPCO1	Y																							X			
NYCTAGINACEAE	Mirabilis linearis (Pursh.) Heimerl	MILI1	Y									X																	
PLANTAGINACE	Plantago lanceolata L.	PLLA1	N		X			X		X													X		X	X			
PLANTAGINACE	Plantago patagonica Jacq.	PLPA1	Y					X												X		X							
POACEAE	Aegilops cylindrica Host	AECY1	N	X																						X			X
POACEAE	Agropyron caninum (L.) Beauv. ssp. majus (Vasey) C. L. Hitchc.	AGCA1	Y		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
POACEAE	Agropyron cristatum (L.) Gaertn.	AGCR1	N													X									X				
POACEAE	Agropyron dasystachyum (Hook.) Scribn.	AGDA1	Y					X						X							X								
POACEAE	Agropyron intermedium (Host) Beauv.	AGIN1	N													X				X								X	
POACEAE	Agropyron smithii Rydb.	AGSM1	Y		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
POACEAE	Andropogon gerardii Vitman	ANGE1	Y					X			X							X	X		X	X	X		X	X			
POACEAE	Andropogon scoparius Michx.	ANSC1	Y															X	X				X						
POACEAE	Bouteloua curtipendula (Michx.) Torr.	BOCU1	Y		X			X	X	X		X	X	X		X		X	X	X	X	X	X		X	X	X	X	X
POACEAE	Bouteloua gracilis (H. B. K.) Lag ex Griffiths	BOGR1	Y			X		X		X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
POACEAE	Bromus inermis Leyss. ssp. inermis	BRIN1	N							X			X	X		X		X						X	X	X			
POACEAE	Bromus japonicus Thunb. ex Murr.	BRJA1	N		X		X						X							X			X	X		X			
POACEAE	Bromus tectorum L.	BRTE1	N	X		X		X		X	X		X	X		X	X	X	X	X	X		X	X	X	X		X	X
POACEAE	Buchloe dactyloides (Nutt.) Engelm.	BUDA1	Y				X	X		X		X		X				X	X		X	X	X		X	X		X	
POACEAE	Digitaria sanguinalis (L.) Scop.	DISA1	N																	X									
POACEAE	Echinochloa crusgallii (L.) Beauv.	ECCR1	N		X																								
POACEAE	Elymus canadensis L.	ELCA1	Y							X	X																		
POACEAE	Festuca pratensis Huds.	FEPR1	N															X					X			X			
POACEAE	Hordeum jubatum L.	HOJU1	Y							X			X				X						X		X				
POACEAE	Hordeum pusillum Nutt.	HOPU1	Y						X								X												
POACEAE	Koeleria pyramidata (Lam.) Beauv.	KOPY1	Y																		X		X						
POACEAE	Muhlenbergia montana (Nutt.) Hitchc.	MUMO1	Y															X											
POACEAE	Poa compressa L.	POCO1	N		X					X		X							X				X	X					
POACEAE	Poa pratensis L.	POPR1	N										X											X	X				
POACEAE	Setaria viridis (L.) Beauv.	SEVI1	N		X				X	X											X								
POACEAE	Sorghastrum nutans (L.) Nash	SONU1	Y							X				X				X			X								
POACEAE	Sporobolus asper (Michx.) Kunth	SPAS1	Y																							X		X	
POACEAE	Sporobolus cryptandrus (Torr.) A. Gray	SPCR1	Y															X			X	X							
POACEAE	Stipa comata Trin. & Rupr.	STCO1	Y																					X					
POACEAE	Stipa viridula Trin.	STVI1	Y																							X		X	
POACEAE	Triticum aestivum L.	TRAE1	N		X	X			X		X		X		X		X			X						X			X
POLYGONACEAE	Polygonum arenastrum Jord. ex Bor.	POAR1	N		X	X		X	X		X		X		X	X	X			X					X				
POLYGONACEAE	Polygonum persicaria L.	POPE2	N		X																								
POLYGONACEAE	Rumex crispus L.	RUCR1	N													X													
SANTALACEAE	Comandra umbellata (L.) Nutt.	COUM1	Y																X										
SCROPHULARIACEAE	Linaria dalmatica (L.) Mill.	LIDA1	N	X								X														X			
SCROPHULARIACEAE	Verbascum thapsus L.	VETH1	N	X																	X		X			X			
SOLANACEAE	Solanum rostratum Dun.	SORO1	Y								X																		
VERBENACEAE	Verbena bracteata Lag. & Rodr.	VEBR1	Y		X	X	X	X	X		X	X			X	X			X	X	X	X	X		X	X			
	Unknown species	UNKN								X							X				X	X		X					
		Total Number of Species			30	13	13	27	17	22	20	18	22	9	14	28	19	15	19	22	31	21	25	25	32	39	10	10	15

Shaded species are those that were seeded.

This page intentionally left blank

Slightly different seed mixes were used at the different locations depending on the year they were seeded and the slope position. One of the success criteria in the Revegetation Plan (DOE 2005c) states that at least 50 percent of the seeded species must be present in an area for it to be considered successful. Table 6−8 lists the location, number of seeded species, number of species present at the location, and percentage present at the location in 2006. Fifteen locations had 50 percent or more seeded species present in 2006 and have thus meet this success criterion. The drought conditions experienced during 2006 may have limited the amount of germination of seeded species at the other locations. When normal precipitation returns it is expected that additional species should germinate and establish at the locations.

Table 6−8. Number of Seeded Species Present in 2006 Summary

Location	# Species Seeded at Location	# Seeded Species Present in 2006	% Seeded Species Present in 2006
A1	11	3	27
A2	11	3	27
A3	7	3	43
A4	11	7	64
A5	11	3	27
A6	11	7	64
A7	12	5	42
A8	7	5	71
A9	7	4	57
A10	14	7	50
A11	11	3	27
A12	12	4	33
A13	11	3	27
A14	14	9	64
A15	13	7	54
A16	11	4	36
A17	11	10	91
A18	11	7	64
A19	13	7	54
A20	14	3	21
A21	11	6	55
A22	12	7	58
A23	7	4	57
A24	10	6	60
A25	7	4	57

Note: Shaded locations pass success criteria in 2006.

Ground cover protection from rock, litter, and current year live vegetation varied from 40 percent to over 100 percent at the revegetation locations in 2006 (Table 6−9). The occasional values over 100 percent are a result of the cover class system used for estimating cover which estimates cover values into a range and uses the midpoint of the cover class for analysis. Another success criterion outlined in the Revegetation Plan (DOE 2005c), states a minimum of 70 percent total ground cover comprised of litter cover, current year live vegetation basal cover, and rock cover is to be present to help prevent erosion. Fourteen locations met this criteria in 2006. At each of the locations most of the cover came from rock. In time the dominant ground cover will shift

from rock to litter as dead plant matter falls to the ground at the end of each growing season and builds up over time, covering and protecting the soil even more.

Table 6−9. 2006 Rock, Litter, and Basal Vegetation Cover Summary

Location	Basal Veg Cover	Rock Cover	Litter Cover	Total Ground Cover
A1	3.7	54.2	7.8	65.6
A2	2.3	52.6	14.8	69.6
A3	2.5	8.8	72.3	83.5
A4	2.9	38.8	37.0	78.8
A5	2.8	43.7	5.3	51.8
A6	6.3	29.8	25.0	61.0
A7	2.3	47.7	6.0	55.9
A8	3.8	18.0	79.5	101.3
A9	2.8	27.0	9.7	39.5
A10	6.3	7.5	66.3	80.0
A11	2.5	43.8	12.7	58.9
A12	5.1	20.3	15.8	41.1
A13	2.5	47.8	25.0	75.3
A14	10.0	33.0	7.3	50.3
A15	2.5	21.0	75.2	98.7
A16	2.5	54.5	19.8	76.8
A17	2.5	57.3	18.3	78.0
A18	2.5	47.8	12.3	62.5
A19	3.3	13.3	79.0	95.7
A20	2.5	3.3	71.3	77.0
A21	2.3	35.0	28.8	66.1
A22	5.8	17.9	50.7	74.4
A23	2.5	9.8	90.0	102.3
A24	15.0	2.8	85.8	103.5
A25	3.1	11.3	85.0	99.3

Notes: All values are percentages.
Some values exceed 100% because of the use of cover class midpoints for data collection and analyses.
Shaded locations pass success criteria in 2006.

A third success criterion outlined in the Revegetation Plan (DOE 2005c), states that a minimum of 30 percent relative cover of desired species must be present and a forth criterion states that no single species comprise more than 45 percent of the total relative cover. Table 6−10 through Table 6−14 summarize the foliar cover data by location for 2006. The shaded row titled Total Native Cover represents the percentage of desired species at each location. The relative cover values at individual locations that are higher than 30 percent are shaded, indicating these locations have met this success criterion.

Total relative vegetation cover of desired (native) species was greater than 30 percent at 19 of the 25 locations in 2006. Only two of the 25 revegetation locations had a single species that comprised greater than 45 percent of the relative cover at the location, A10 and A19. At each of these locations 49 percent of the cover came from slender wheatgrass, one of the early successional seeded native species. Thus all locations except A10 and A19 met this latter success criterion. The dominant species across all sites in 2006 were slender wheatgrass, western wheatgrass, wheat (*Triticum aestivum*), kochia, and yellow sweetclover.

Table 6−10. Species Foliar Cover Summary at Locations A1−A5

Scientific Name	Speccode	Growth Form	Native	Cool/ Warm Season	Noxious Weed	A1		A2		A3		A4		A5	
						Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)
Alyssum alyssoides (L.) L.	ALAL1	F	N												
Alyssum minus (L.) Rothmaler var. micranthus (C. A. Mey.) Dudley	ALMI1	F	N			0.8	2.2			0.3	0.8	0.1	0.2	0.1	0.5
Amaranthus albus L.	AMAL2	F	N												
Carduus nutans L. ssp. macrolepis (Peterm.) Kazmi	CANU1	F	N		X							0.1	0.2		
Centaurea diffusa Lam.	CEDI1	F	N		X	0.2	0.4	0.1	0.5	9.3	31.1	2.8	8.1	0.1	0.5
Chenopodium album L.	CHAL1	F	N			0.7	1.8								
Chrysanthemum leucanthemum L.	CHLE1	F	N		X										
Cirsium arvense (L.) Scop.	CIAR1	F	N		X							0.6	1.7		
Convolvulus arvensis L.	COAR1	F	N		X	0.1	0.2			0.3	0.8	0.8	2.2		
Dyssodia papposa (Vent) Hitchc.	DYPA1	F	N												
Erodium cicutarium (L.) L'Her.	ERCI1	F	N		X	1.8	4.9	0.3	1.4	0.3	0.8	0.8	2.2	0.6	3.2
Kochia scoparia (L.) Schrad.	KOSC1	F	N			4.0	10.8	3.9	22.2	2.5	8.4	6.5	19.1	4.3	23.9
Lactuca serriola L.	LASE1	F	N			1.5	4.0	0.3	1.4	0.5	1.7	0.6	1.7	0.6	3.2
Lepidium campestre (L.) R. Br.	LECA1	F	N			0.1	0.2								
Linaria dalmatica (L.) Mill.	LIDA1	F	N		X										
Marrubium vulgare L.	MAVU1	F	N												
Melilotus alba Medic.	MEAL1	F	N												
Medicago lupulina L.	MELU1	F	N									1.1	3.2		
Melilotus officinalis (L.) Pall.	MEOF1	F	N			1.7	4.5	0.8	4.2	0.8	2.5	0.8	2.5	2.5	13.8
Medicago sativa L. ssp. sativa	MESA1	F	N												
Plantago lanceolata L.	PLLA1	F	N			0.3	0.7					0.2	0.5		
Polygonum arenastrum Jord. ex Bor.	POAR1	F	N			4.3	11.5	0.7	3.8			1.1	3.2	0.8	4.6
Polygonum persicaria L.	POPE2	F	N			0.1	0.2								
Rumex crispus L.	RUCR1	F	N												
Salsola iberica Senn. & Pau.	SAIB1	F	N			3.7	9.9	0.2	0.9			0.1	0.2	0.9	5.0
Scorzonera laciniata L.	SCLA1	F	N			0.3	0.7								
Sisymbrium altissimum L.	SIAL1	F	N			0.2	0.4								
Sonchus arvensis L. ssp. uglinosus (Bieb.) Nyman	SOAR2	F	N			0.1	0.2							0.1	0.5
Taraxacum officinale Weber	TAOF1	F	N												
Tragopogon dubius Scop.	TRDU1	F	N			0.2	0.4					0.2	0.5		
Verbascum thapsus L.	VETH1	F	N		X										
Ambrosia artemisiifolia L.	AMAR1	F	Y			1.2	3.1					0.1	0.2		
Ambrosia psilostachya DC.	AMPS1	F	Y												
Artemisia campestris L. ssp. caudata (Michx.) Hall & Clem.	ARCA1	F	Y												
Artemisia frigida Willd.	ARFR1	F	Y												
Astragalus canadensis L.	ASCA1	F	Y									0.5	1.5		
Aster porteri Gray	ASPO1	F	Y												
Asclepias speciosa Torr.	ASSP1	F	Y												
Chenopodium fremontii S. Wats.	CHFR1	F	Y			0.1	0.2							0.1	0.5
Chrysopsis fulcrata Greene	CHFU1	F	Y												
Chenopodium leptophyllum Nutt. ex Moq.	CHLE2	F	Y												
Conyza canadensis (L.) Cronq.	COCA1	F	Y												
Comandra umbellata (L.) Nutt.	COUM1	F	Y												

Table 6−10 (continued). Species Foliar Cover Summary at Locations A1−A5

Scientific Name	Speccode	Growth Form	Native	Cool/ Warm Season	Noxious Weed	A1		A2		A3		A4		A5	
						Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)
Erysimum capitatum (Nutt.) DC.	ERCA2	F	Y												
Erigeron divergens T. & G.	ERDI1	F	Y												
Euphorbia serpyllifolia Pers.	EUSE1	F	Y												
Grindelia squarrosa (Pursh.) Dun.	GRSQ1	F	Y			0.8	2.2			0.5	1.7	0.3	0.7		
Helianthus annuus L.	HEAN1	F	Y			0.1	0.2								
Lesquerella montana (A. Gray) Wats.	LEMO1	F	Y												
Linum perenne L. var. lewisii (Pursh.) Eat. & Wright	LIPE1	F	Y												
Liatris punctata Hook.	LIPU1	F	Y												
Mirabilis linearis (Pursh.) Heimerl	MILI1	F	Y												
Onosmodium molle Michx. var. occidentale (Mack.) Johnst.	ONMO1	F	Y												
Plantago patagonica Jacq.	PLPA1	F	Y									0.1	0.2		
Psoralea tenuiflora Pursh.	PSTE1	F	Y												
Solanum rostratum Dun.	SORO1	F	Y												
Sphaeralcea coccinea (Pursh.) Rydb.	SPCO1	F	Y												
Thelesperma megapotanicum (Spreng.) O. Ktze.	THME1	F	Y												
Verbena bracteata Lag. & Rodr.	VEBR1	F	Y			0.1	0.2	0.1	0.5	0.3	0.8	0.8	2.2	0.2	0.9
Aegilops cylindrica Host	AECY1	G	N	C	X										
Agropyron cristatum (L.) Gaertn.	AGCR1	G	N	C											
Agropyron intermedium (Host) Beauv.	AGIN1	G	N	C											
Bromus inermis Leyss. ssp. inermis	BRIN1	G	N	C											
Bromus japonicus Thunb. ex Murr.	BRJA1	G	N	C		0.2	0.4			0.3	0.8				
Bromus tectorum L.	BRTE1	G	N	C	X			0.2	0.9			0.8	2.5		
Festuca pratensis Huds.	FEPR1	G	N	C											
Poa compressa L.	POCO1	G	N	C		0.2	0.4								
Poa pratensis L.	POPR1	G	N	C											
Triticum aestivum L.	TRAE1	G	N	C		7.8	20.9	7.2	40.6					3.6	19.7
Digitaria sanguinalis (L.) Scop.	DISA1	G	N	W											
Echinochloa crusgallii (L.) Beauv.	ECCR1	G	N	W		0.2	0.4								
Setaria viridis (L.) Beauv.	SEVI1	G	N	W		0.1	0.2							0.1	0.5
Agropyron caninum (L.) Beauv. ssp. majus (Vasey) C. L. Hitchc.	AGCA1	G	Y	C		5.6	15.1	2.5	14.2	11.0	37.0	8.4	24.8	3.1	17.0
Agropyron dasystachyum (Hook.) Scribn.	AGDA1	G	Y	C								1.3	3.7		
Agropyron smithii Rydb.	AGSM1	G	Y	C		1.0	2.7	1.5	8.5	1.8	5.9	2.9	8.6	1.0	5.5
Elymus canadensis L.	ELCA1	G	Y	C											
Hordeum jubatum L.	HOJU1	G	Y	C											
Hordeum pusillum Nutt.	HOPU1	G	Y	C										0.1	0.5
Koeleria pyramidata (Lam.) Beauv.	KOPY1	G	Y	C											
Stipa comata Trin. & Rupr.	STCO1	G	Y	C											
Stipa viridula Trin.	STVI1	G	Y	C											
Andropogon gerardii Vitman	ANGE1	G	Y	W								0.1	0.2		
Andropogon scoparius Michx.	ANSC1	G	Y	W											
Bouteloua curtipendula (Michx.) Torr.	BOCU1	G	Y	W		0.2	0.4					1.4	4.2	0.1	0.5
Bouteloua gracilis (H. B. K.) Lag ex Griffiths	BOGR1	G	Y	W				0.2	0.9			1.8	5.1		
Buchloe dactyloides (Nutt.) Engelm.	BUDA1	G	Y	W						2.3	7.6	0.2	0.5		
Muhlenbergia montana (Nutt.) Hitchc.	MUMO1	G	Y	W											

Table 6−10 (continued). Species Foliar Cover Summary at Locations A1−A5

Scientific Name	Speccode	Growth Form	Native	Cool/ Warm Season	Noxious Weed	A1		A2		A3		A4		A5	
						Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)
Sorghastrum nutans (L.) Nash	SONU1	G	Y	W											
Sporobolus asper (Michx.) Kunth	SPAS1	G	Y	W											
Sporobolus cryptandrus (Torr.) A. Gray	SPCR1	G	Y	W											
Unknown species	UNKN														
Total Foliar Cover						37.1	100.0	17.7	100.0	29.8	100.0	34.0	100.0	18.2	100.0
Total Forb Cover						22.0	59.3	6.2	34.9	14.5	48.7	17.2	50.5	10.3	56.4
Total Non-Native Forb Cover						19.8	53.3	6.1	34.4	13.8	46.2	15.5	45.6	10.0	55.0
Total Native Forb Cover						2.3	6.1	0.1	0.5	0.8	2.5	1.7	4.9	0.3	1.4
Total Graminoid Cover						15.1	40.7	11.5	65.1	15.3	51.3	16.8	49.5	7.9	43.6
Total Non-Native Graminoid Cover						8.3	22.5	7.3	41.5	0.3	0.8	0.8	2.5	3.7	20.2
Total Native Graminoid Cover						6.8	18.2	4.2	23.6	15.0	50.4	16.0	47.1	4.3	23.4
Total Native Cover						9.0	24.3	4.3	24.1	15.8	52.9	17.7	52.0	4.5	24.8
Total Non-Native Cover						28.1	75.7	13.4	75.9	14.0	47.1	16.3	48.0	13.7	75.2
Total Warm-Season Graminoid Cover						0.4	1.1	0.2	0.9	2.3	7.6	3.4	10.0	0.2	0.9
Total Cool-Season Graminoid Cover						14.7	39.6	11.3	64.2	13.0	43.7	13.4	39.5	7.7	42.7
Total Noxious Weed Cover						2.1	5.6	0.5	2.8	9.8	32.8	5.8	16.9	0.7	3.7

Absolute Cover = The percentage of the number of hits on a species out of the total number of hits possible.
Relative Cover = The percentage of the number of hits on a species out of the total number of vegetation hits.
Native Categories: Y = Native, N = Non-Native
Growth Form Categories: F = Forb, G = Graminoid
Cool/Warm Season Categories: C = Cool-Season Graminoid, W = Warm-Season Graminoid
Noxious Weed Category: X = Noxious Weed (listed on May 2006 Colorado State Noxious Weed List)
Shaded cells indicate success criteria were met in 2006.

Table 6−11. Species Foliar Cover Summary at Locations A6−A10

Scientific Name	Speccode	Growth Form	Native	Cool/ Warm Season	Noxious Weed	A6		A7		A8		A9		A10	
						Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)
Alyssum alyssoides (L.) L.	ALAL1	F	N												
Alyssum minus (L.) Rothmaler var. micranthus (C. A. Mey.) Dudley	ALMI1	F	N			0.3	0.6			0.3	0.5				
Amaranthus albus L.	AMAL2	F	N												
Carduus nutans L. ssp. macrolepis (Peterm.) Kazmi	CANU1	F	N		X										
Centaurea diffusa Lam.	CEDI1	F	N		X	0.3	0.6	0.5	5.3	4.8	9.7	1.8	10.4		
Chenopodium album L.	CHAL1	F	N					0.1	0.9						
Chrysanthemum leucanthemum L.	CHLE1	F	N		X										
Cirsium arvense (L.) Scop.	CIAR1	F	N		X							0.5	2.8		
Convolvulus arvensis L.	COAR1	F	N		X	1.5	3.7	0.1	0.9						
Dyssodia papposa (Vent) Hitchc.	DYPA1	F	N												
Erodium cicutarium (L.) L'Her.	ERCI1	F	N		X	0.5	1.2	1.3	14.0						
Kochia scoparia (L.) Schrad.	KOSC1	F	N			5.3	12.8	0.1	0.9			2.3	12.8		
Lactuca serriola L.	LASE1	F	N			0.3	0.6			0.3	0.5	1.3	7.1		
Lepidium campestre (L.) R. Br.	LECA1	F	N							0.5	1.0				
Linaria dalmatica (L.) Mill.	LIDA1	F	N		X					1.8	3.6				
Marrubium vulgare L.	MAVU1	F	N												
Melilotus alba Medic.	MEAL1	F	N			1.5	3.7					0.1	0.5		
Medicago lupulina L.	MELU1	F	N												
Melilotus officinalis (L.) Pall.	MEOF1	F	N			0.8	1.8	0.8	7.9	1.8	3.6	3.7	20.9		
Medicago sativa L. ssp. sativa	MESA1	F	N												
Plantago lanceolata L.	PLLA1	F	N			0.3	0.6								
Polygonum arenastrum Jord. ex Bor.	POAR1	F	N					0.1	0.9			0.1	0.5		
Polygonum persicaria L.	POPE2	F	N												
Rumex crispus L.	RUCR1	F	N												
Salsola iberica Senn. & Pau.	SAIB1	F	N					0.1	0.9			0.8	4.7		
Scorzonera laciniata L.	SCLA1	F	N												
Sisymbrium altissimum L.	SIAL1	F	N												
Sonchus arvensis L. ssp. uglinosus (Bieb.) Nyman	SOAR2	F	N												
Taraxacum officinale Weber	TAOF1	F	N												
Tragopogon dubius Scop.	TRDU1	F	N							0.3	0.5	0.2	0.9		
Verbascum thapsus L.	VETH1	F	N		X										
Ambrosia artemisiifolia L.	AMAR1	F	Y												
Ambrosia psilostachya DC.	AMPS1	F	Y									0.1	0.5		
Artemisia campestris L. ssp. caudata (Michx.) Hall & Clem.	ARCA1	F	Y												
Artemisia frigida Willd.	ARFR1	F	Y												
Astragalus canadensis L.	ASCA1	F	Y							0.3	0.5				
Aster porteri Gray	ASPO1	F	Y							0.5	1.0				
Asclepias speciosa Torr.	ASSP1	F	Y												
Chenopodium fremontii S. Wats.	CHFR1	F	Y												
Chrysopsis fulcrata Greene	CHFU1	F	Y												
Chenopodium leptophyllum Nutt. ex Moq.	CHLE2	F	Y					0.5	5.3						
Conyza canadensis (L.) Cronq.	COCA1	F	Y												
Comandra umbellata (L.) Nutt.	COUM1	F	Y												

Table 6−11 (continued). Species Foliar Cover Summary at Locations A6−A10

Scientific Name	Speccode	Growth Form	Native	Cool/ Warm Season	Noxious Weed	A6		A7		A8		A9		A10	
						Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)
Erysimum capitatum (Nutt.) DC.	ERCA2	F	Y					0.1	0.9						
Erigeron divergens T. & G.	ERDI1	F	Y												
Euphorbia serpyllifolia Pers.	EUSE1	F	Y												
Grindelia squarrosa (Pursh.) Dun.	GRSQ1	F	Y							7.0	14.3	0.6	3.3		
Helianthus annuus L.	HEAN1	F	Y									0.2	0.9		
Lesquerella montana (A. Gray) Wats.	LEMO1	F	Y					0.1	0.9						
Linum perenne L. var. lewisii (Pursh.) Eat. & Wright	LIPE1	F	Y												
Liatris punctata Hook.	LIPU1	F	Y												
Mirabilis linearis (Pursh.) Heimerl	MILI1	F	Y							0.3	0.5				
Onosmodium molle Michx. var. occidentale (Mack.) Johnst.	ONMO1	F	Y												
Plantago patagonica Jacq.	PLPA1	F	Y												
Psoralea tenuiflora Pursh.	PSTE1	F	Y												
Solanum rostratum Dun.	SORO1	F	Y					0.5	5.3						
Sphaeralcea coccinea (Pursh.) Rydb.	SPCO1	F	Y												
Thelesperma megapotanicum (Spreng.) O. Ktze.	THME1	F	Y												
Verbena bracteata Lag. & Rodr.	VEBR1	F	Y					0.6	6.1	0.3	0.5				
Aegilops cylindrica Host	AECY1	G	N	C	X										
Agropyron cristatum (L.) Gaertn.	AGCR1	G	N	C											
Agropyron intermedium (Host) Beauv.	AGIN1	G	N	C											
Bromus inermis Leyss. ssp. inermis	BRIN1	G	N	C		5.5	13.4					0.2	0.9	2.0	3.9
Bromus japonicus Thunb. ex Murr.	BRJA1	G	N	C								0.1	0.5		
Bromus tectorum L.	BRTE1	G	N	C	X	0.3	0.6	0.3	2.6			0.1	0.5	0.5	1.0
Festuca pratensis Huds.	FEPR1	G	N	C											
Poa compressa L.	POCO1	G	N	C		0.5	1.2			2.3	4.6				
Poa pratensis L.	POPR1	G	N	C								0.1	0.5		
Triticum aestivum L.	TRAE1	G	N	C				1.3	13.2			0.4	2.4		
Digitaria sanguinalis (L.) Scop.	DISA1	G	N	W											
Echinochloa crusgallii (L.) Beauv.	ECCR1	G	N	W											
Setaria viridis (L.) Beauv.	SEVI1	G	N	W		0.5	1.2								
Agropyron caninum (L.) Beauv. ssp. majus (Vasey) C. L. Hitchc.	AGCA1	G	Y	C		13.3	32.3	2.3	23.7	20.3	41.3	2.8	15.6	25.0	48.5
Agropyron dasystachyum (Hook.) Scribn.	AGDA1	G	Y	C										1.5	2.9
Agropyron smithii Rydb.	AGSM1	G	Y	C		2.5	6.1	0.6	6.1	5.3	10.7	1.6	9.0	14.0	27.2
Elymus canadensis L.	ELCA1	G	Y	C		0.3	0.6	0.3	2.6						
Hordeum jubatum L.	HOJU1	G	Y	C		0.5	1.2					0.1	0.5		
Hordeum pusillum Nutt.	HOPU1	G	Y	C											
Koeleria pyramidata (Lam.) Beauv.	KOPY1	G	Y	C											
Stipa comata Trin. & Rupr.	STCO1	G	Y	C											
Stipa viridula Trin.	STVI1	G	Y	C											
Andropogon gerardii Vitman	ANGE1	G	Y	W				0.1	0.9						
Andropogon scoparius Michx.	ANSC1	G	Y	W											
Bouteloua curtipendula (Michx.) Torr.	BOCU1	G	Y	W		1.8	4.3			0.5	1.0	0.4	2.4	0.5	1.0
Bouteloua gracilis (H. B. K.) Lag ex Griffiths	BOGR1	G	Y	W		3.3	7.9	0.1	0.9	1.3	2.6	0.4	2.4	1.5	2.9
Buchloe dactyloides (Nutt.) Engelm.	BUDA1	G	Y	W		1.8	4.3			1.8	3.6			3.5	6.8
Muhlenbergia montana (Nutt.) Hitchc.	MUMO1	G	Y	W											

Table 6−11 (continued). Species Foliar Cover Summary at Locations A6−A10

Scientific Name	Speccode	Growth Form	Native	Cool/ Warm Season	Noxious Weed	A6		A7		A8		A9		A10	
						Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)
Sorghastrum nutans (L.) Nash	SONU1	G	Y	W		0.3	0.6							3.0	5.8
Sporobolus asper (Michx.) Kunth	SPAS1	G	Y	W											
Sporobolus cryptandrus (Torr.) A. Gray	SPCR1	G	Y	W											
Unknown species	UNKN					0.3	0.6								
Total Foliar Cover						41.0	100.0	9.5	100.0	49.0	100.0	17.6	100.0	51.5	100.0
Total Forb Cover						10.5	25.6	4.8	50.0	17.8	36.2	11.5	65.4	0.0	0.0
Total Non-Native Forb Cover						10.5	25.6	3.0	31.6	9.5	19.4	10.7	60.7	0.0	0.0
Total Native Forb Cover						0.0	0.0	1.8	18.4	8.3	16.8	0.8	4.7	0.0	0.0
Total Graminoid Cover						30.3	73.8	4.8	50.0	31.3	63.8	6.1	34.6	51.5	100.0
Total Non-Native Graminoid Cover						6.8	16.5	1.5	15.8	2.3	4.6	0.8	4.7	2.5	4.9
Total Native Graminoid Cover						23.5	57.3	3.3	34.2	29.0	59.2	5.3	29.9	49.0	95.1
Total Native Cover						23.5	57.3	5.0	52.6	37.3	76.0	6.1	34.6	49.0	95.1
Total Non-Native Cover						17.3	42.1	4.5	47.4	11.8	24.0	11.5	65.4	2.5	4.9
Total Warm-Season Graminoid Cover						7.5	18.3	0.2	1.8	3.5	7.1	0.8	4.7	8.5	16.5
Total Cool-Season Graminoid Cover						22.8	55.5	4.6	48.2	27.8	56.6	5.3	29.9	43.0	83.5
Total Noxious Weed Cover						2.5	6.1	2.2	22.8	6.5	13.3	2.4	13.7	0.5	1.0

Absolute Cover = The percentage of the number of hits on a species out of the total number of hits possible.
Relative Cover = The percentage of the number of hits on a species out of the total number of vegetation hits.
Native Categories: Y = Native, N = Non-Native
Growth Form Categories: F = Forb, G = Graminoid
Cool/Warm Season Categories: C = Cool-Season Graminoid, W = Warm-Season Graminoid
Noxious Weed Category: X = Noxious Weed (listed on May 2006 Colorado State Noxious Weed List)
Shaded cells indicate success criteria were met in 2006.

Table 6−12. Species Foliar Cover Summary at Locations A11−A15

Scientific Name	Speccode	Growth Form	Native	Cool/ Warm Season	Noxious Weed	A11		A12		A13		A14		A15	
						Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)
Alyssum alyssoides (L.) L.	ALAL1	F	N												
Alyssum minus (L.) Rothmaler var. micranthus (C. A. Mey.) Dudley	ALMI1	F	N			0.5	2.2	0.3	0.8	0.3	0.7				
Amaranthus albus L.	AMAL2	F	N							0.3	0.7				
Carduus nutans L. ssp. macrolepis (Peterm.) Kazmi	CANU1	F	N		X			0.1	0.3						
Centaurea diffusa Lam.	CEDI1	F	N		X	0.1	0.4	8.8	28.1	0.8	2.1	5.3	12.0	1.0	2.6
Chenopodium album L.	CHAL1	F	N							3.5	9.9				
Chrysanthemum leucanthemum L.	CHLE1	F	N		X										
Cirsium arvense (L.) Scop.	CIAR1	F	N		X			0.2	0.6						
Convolvulus arvensis L.	COAR1	F	N		X			1.1	3.6						
Dyssodia papposa (Vent) Hitchc.	DYPA1	F	N												
Erodium cicutarium (L.) L'Her.	ERCI1	F	N		X	0.6	2.6	0.1	0.3	0.3	0.7				
Kochia scoparia (L.) Schrad.	KOSC1	F	N			9.0	39.9	2.8	8.8	3.3	9.2				
Lactuca serriola L.	LASE1	F	N			0.1	0.4	1.5	4.7	1.8	4.9			0.5	1.3
Lepidium campestre (L.) R. Br.	LECA1	F	N							0.3	0.7			0.2	0.4
Linaria dalmatica (L.) Mill.	LIDA1	F	N		X										
Marrubium vulgare L.	MAVU1	F	N					0.1	0.3						
Melilotus alba Medic.	MEAL1	F	N					1.4	4.4						
Medicago lupulina L.	MELU1	F	N												
Melilotus officinalis (L.) Pall.	MEOF1	F	N			3.1	13.7	5.3	17.1	0.5	1.4			1.3	3.5
Medicago sativa L. ssp. sativa	MESA1	F	N					0.1	0.3						
Plantago lanceolata L.	PLLA1	F	N												
Polygonum arenastrum Jord. ex Bor.	POAR1	F	N			0.8	3.3	0.3	0.8	0.5	1.4				
Polygonum persicaria L.	POPE2	F	N												
Rumex crispus L.	RUCR1	F	N					0.5	1.7						
Salsola iberica Senn. & Pau.	SAIB1	F	N			1.4	6.3	0.9	2.8	1.8	4.9				
Scorzonera laciniata L.	SCLA1	F	N												
Sisymbrium altissimum L.	SIAL1	F	N												
Sonchus arvensis L. ssp. uglinosus (Bieb.) Nyman	SOAR2	F	N												
Taraxacum officinale Weber	TAOF1	F	N					0.1	0.3					0.2	0.4
Tragopogon dubius Scop.	TRDU1	F	N					0.2	0.6						
Verbascum thapsus L.	VETH1	F	N		X										
Ambrosia artemisiifolia L.	AMAR1	F	Y												
Ambrosia psilostachya DC.	AMPS1	F	Y			0.1	0.4								
Artemisia campestris L. ssp. caudata (Michx.) Hall & Clem.	ARCA1	F	Y												
Artemisia frigida Willd.	ARFR1	F	Y												
Astragalus canadensis L.	ASCA1	F	Y												
Aster porteri Gray	ASPO1	F	Y											0.2	0.4
Asclepias speciosa Torr.	ASSP1	F	Y												
Chenopodium fremontii S. Wats.	CHFR1	F	Y												
Chrysopsis fulcrata Greene	CHFU1	F	Y												
Chenopodium leptophyllum Nutt. ex Moq.	CHLE2	F	Y												
Conyza canadensis (L.) Cronq.	COCA1	F	Y											0.5	1.3

Table 6−12 (continued). Species Foliar Cover Summary at Locations A11−A15

Scientific Name	Speccode	Growth Form	Native	Cool/ Warm Season	Noxious Weed	A11		A12		A13		A14		A15	
						Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)
Comandra umbellata (L.) Nutt.	COUM1	F	Y											0.2	0.4
Erysimum capitatum (Nutt.) DC.	ERCA2	F	Y												
Erigeron divergens T. & G.	ERDI1	F	Y												
Euphorbia serpyllifolia Pers.	EUSE1	F	Y							0.5	1.4				
Grindelia squarrosa (Pursh.) Dun.	GRSQ1	F	Y					0.1	0.3					0.2	0.4
Helianthus annuus L.	HEAN1	F	Y					0.1	0.3						
Lesquerella montana (A. Gray) Wats.	LEMO1	F	Y												
Linum perenne L. var. lewisii (Pursh.) Eat. & Wright	LIPE1	F	Y												
Liatris punctata Hook.	LIPU1	F	Y									0.3	0.6		
Mirabilis linearis (Pursh.) Heimerl	MILI1	F	Y												
Onosmodium molle Michx. var. occidentale (Mack.) Johnst.	ONMO1	F	Y												
Plantago patagonica Jacq.	PLPA1	F	Y												
Psoralea tenuiflora Pursh.	PSTE1	F	Y												
Solanum rostratum Dun.	SORO1	F	Y												
Sphaeralcea coccinea (Pursh.) Rydb.	SPCO1	F	Y												
Thelesperma megapotanicum (Spreng.) O. Ktze.	THME1	F	Y												
Verbena bracteata Lag. & Rodr.	VEBR1	F	Y			0.3	1.5	1.6	5.2					2.3	6.1
Aegilops cylindrica Host	AECY1	G	N	C	X										
Agropyron cristatum (L.) Gaertn.	AGCR1	G	N	C				0.2	0.6						
Agropyron intermedium (Host) Beauv.	AGIN1	G	N	C				0.1	0.3						
Bromus inermis Leyss. ssp. inermis	BRIN1	G	N	C				0.2	0.6			0.3	0.6		
Bromus japonicus Thunb. ex Murr.	BRJA1	G	N	C											
Bromus tectorum L.	BRTE1	G	N	C	X			0.1	0.3	0.5	1.4	0.3	0.6	0.2	0.4
Festuca pratensis Huds.	FEPR1	G	N	C								1.5	3.4		
Poa compressa L.	POCO1	G	N	C										0.2	0.4
Poa pratensis L.	POPR1	G	N	C											
Triticum aestivum L.	TRAE1	G	N	C		5.3	23.2			7.3	20.4				
Digitaria sanguinalis (L.) Scop.	DISA1	G	N	W											
Echinochloa crusgallii (L.) Beauv.	ECCR1	G	N	W											
Setaria viridis (L.) Beauv.	SEVI1	G	N	W											
Agropyron caninum (L.) Beauv. ssp. majus (Vasey) C. L. Hitchc.	AGCA1	G	Y	C		0.8	3.7	1.7	5.5	7.0	19.7	12.0	27.4	14.7	38.6
Agropyron dasystachyum (Hook.) Scribn.	AGDA1	G	Y	C											
Agropyron smithii Rydb.	AGSM1	G	Y	C		0.5	2.2	2.2	6.9	4.0	11.3	0.3	0.6	2.2	5.7
Elymus canadensis L.	ELCA1	G	Y	C											
Hordeum jubatum L.	HOJU1	G	Y	C						1.5	4.2				
Hordeum pusillum Nutt.	HOPU1	G	Y	C											
Koeleria pyramidata (Lam.) Beauv.	KOPY1	G	Y	C											
Stipa comata Trin. & Rupr.	STCO1	G	Y	C											
Stipa viridula Trin.	STVI1	G	Y	C											
Andropogon gerardii Vitman	ANGE1	G	Y	W								1.5	3.4	5.5	14.5
Andropogon scoparius Michx.	ANSC1	G	Y	W								0.8	1.7	0.2	0.4
Bouteloua curtipendula (Michx.) Torr.	BOCU1	G	Y	W				0.1	0.3			9.3	21.1	6.2	16.2
Bouteloua gracilis (H. B. K.) Lag ex Griffiths	BOGR1	G	Y	W		0.1	0.4	1.5	4.7	0.3	0.7	3.5	8.0	0.5	1.3
Buchloe dactyloides (Nutt.) Engelm.	BUDA1	G	Y	W								5.8	13.1	2.0	5.3

Table 6−12 (continued). Species Foliar Cover Summary at Locations A11−A15

Scientific Name	Speccode	Growth Form	Native	Cool/ Warm Season	Noxious Weed	A11		A12		A13		A14		A15	
						Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)
Muhlenbergia montana (Nutt.) Hitchc.	MUMO1	G	Y	W								1.5	3.4		
Sorghastrum nutans (L.) Nash	SONU1	G	Y	W								1.5	3.4		
Sporobolus asper (Michx.) Kunth	SPAS1	G	Y	W											
Sporobolus cryptandrus (Torr.) A. Gray	SPCR1	G	Y	W								0.3	0.6		
Unknown species	UNKN									1.5	4.2				
Total Foliar Cover						22.6	100.0	31.3	100.0	35.5	100.0	43.8	100.0	38.0	100.0
Total Forb Cover						15.9	70.5	25.3	81.0	13.5	38.0	5.5	12.6	6.5	17.1
Total Non-Native Forb Cover						15.5	68.6	23.5	75.2	13.0	36.6	5.3	12.0	3.2	8.3
Total Native Forb Cover						0.4	1.8	1.8	5.8	0.5	1.4	0.3	0.6	3.3	8.8
Total Graminoid Cover						6.7	29.5	5.9	19.0	20.5	57.7	38.3	87.4	31.5	82.9
Total Non-Native Graminoid Cover						5.3	23.2	0.5	1.7	7.8	21.8	2.0	4.6	0.3	0.9
Total Native Graminoid Cover						1.4	6.3	5.4	17.4	12.8	35.9	36.3	82.9	31.2	82.0
Total Native Cover						1.8	8.1	7.2	23.1	13.3	37.3	36.5	83.4	34.5	90.8
Total Non-Native Cover						20.8	91.9	24.1	76.9	20.8	58.5	7.3	16.6	3.5	9.2
Total Warm-Season Graminoid Cover						0.1	0.4	1.6	5.0	0.3	0.7	24.0	54.9	14.3	37.7
Total Cool-Season Graminoid Cover						6.6	29.2	4.4	14.0	20.3	57.0	14.3	32.6	17.2	45.2
Total Noxious Weed Cover						0.7	3.0	10.3	33.1	1.5	4.2	5.5	12.6	1.2	3.1

Absolute Cover = The percentage of the number of hits on a species out of the total number of hits possible.
Relative Cover = The percentage of the number of hits on a species out of the total number of vegetation hits.
Native Categories: Y = Native, N = Non-Native
Growth Form Categories: F = Forb, G = Graminoid
Cool/Warm Season Categories: C = Cool-Season Graminoid, W = Warm-Season Graminoid
Noxious Weed Category: X = Noxious Weed (listed on May 2006 Colorado State Noxious Weed List)
Shaded cells indicate success criteria were met in 2006.

Table 6−13. Species Foliar Cover Summary at Locations A16−A20

Scientific Name	Speccode	Growth Form	Native	Cool/ Warm Season	Noxious Weed	A16		A17		A18		A19		A20	
						Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)
Alyssum alyssoides (L.) L.	ALAL1	F	N											0.3	0.5
Alyssum minus (L.) Rothmaler var. micranthus (C. A. Mey.) Dudley	ALMI1	F	N			2.5	4.8	0.5	1.0					1.5	2.8
Amaranthus albus L.	AMAL2	F	N												
Carduus nutans L. ssp. macrolepis (Peterm.) Kazmi	CANU1	F	N		X										
Centaurea diffusa Lam.	CEDI1	F	N		X	3.5	6.8	0.3	0.5	1.5	3.9	1.2	2.7	2.0	3.7
Chenopodium album L.	CHAL1	F	N							0.3	0.7				
Chrysanthemum leucanthemum L.	CHLE1	F	N		X					0.3	0.7				
Cirsium arvense (L.) Scop.	CIAR1	F	N		X										
Convolvulus arvensis L.	COAR1	F	N		X					0.5	1.3	0.2	0.4	1.0	1.8
Dyssodia papposa (Vent) Hitchc.	DYPA1	F	N			0.8	1.4	0.8	1.5	0.3	0.7				
Erodium cicutarium (L.) L'Her.	ERCI1	F	N		X	6.3	12.1	7.0	14.4	2.0	5.3	1.3	3.1	0.5	0.9
Kochia scoparia (L.) Schrad.	KOSC1	F	N			0.3	0.5	0.8	1.5						
Lactuca serriola L.	LASE1	F	N			3.8	7.2	0.5	1.0	0.3	0.7	0.8	1.9		
Lepidium campestre (L.) R. Br.	LECA1	F	N									0.2	0.4		
Linaria dalmatica (L.) Mill.	LIDA1	F	N		X										
Marrubium vulgare L.	MAVU1	F	N					0.3	0.5						
Melilotus alba Medic.	MEAL1	F	N									0.2	0.4		
Medicago lupulina L.	MELU1	F	N												
Melilotus officinalis (L.) Pall.	MEOF1	F	N			11.8	22.7	3.3	6.7	7.8	20.4	1.3	3.1	0.3	0.5
Medicago sativa L. ssp. sativa	MESA1	F	N												
Plantago lanceolata L.	PLLA1	F	N									0.2	0.4		
Polygonum arenastrum Jord. ex Bor.	POAR1	F	N			1.5	2.9								
Polygonum persicaria L.	POPE2	F	N												
Rumex crispus L.	RUCR1	F	N												
Salsola iberica Senn. & Pau.	SAIB1	F	N			4.5	8.7	1.0	2.1						
Scorzonera laciniata L.	SCLA1	F	N											0.3	0.5
Sisymbrium altissimum L.	SIAL1	F	N												
Sonchus arvensis L. ssp. uglinosus (Bieb.) Nyman	SOAR2	F	N												
Taraxacum officinale Weber	TAOF1	F	N									0.2	0.4	0.3	0.5
Tragopogon dubius Scop.	TRDU1	F	N					1.5	3.1	0.3	0.7	0.2	0.4	0.5	0.9
Verbascum thapsus L.	VETH1	F	N		X			1.8	3.6			0.3	0.8		
Ambrosia artemisiifolia L.	AMAR1	F	Y					1.5	3.1	0.3	0.7				
Ambrosia psilostachya DC.	AMPS1	F	Y					0.3	0.5					9.3	17.1
Artemisia campestris L. ssp. caudata (Michx.) Hall & Clem.	ARCA1	F	Y			0.3	0.5							0.3	0.5
Artemisia frigida Willd.	ARFR1	F	Y											1.8	3.2
Astragalus canadensis L.	ASCA1	F	Y												
Aster porteri Gray	ASPO1	F	Y												
Asclepias speciosa Torr.	ASSP1	F	Y												
Chenopodium fremontii S. Wats.	CHFR1	F	Y												
Chrysopsis fulcrata Greene	CHFU1	F	Y												
Chenopodium leptophyllum Nutt. ex Moq.	CHLE2	F	Y												
Conyza canadensis (L.) Cronq.	COCA1	F	Y					0.3	0.5						

Table 6−13 (continued). Species Foliar Cover Summary at Locations A16−A20

Scientific Name	Speccode	Growth Form	Native	Cool/ Warm Season	Noxious Weed	A16		A17		A18		A19		A20	
						Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)
Comandra umbellata (L.) Nutt.	COUM1	F	Y												
Erysimum capitatum (Nutt.) DC.	ERCA2	F	Y												
Erigeron divergens T. & G.	ERDI1	F	Y												
Euphorbia serpyllifolia Pers.	EUSE1	F	Y					0.3	0.5	0.3	0.7				
Grindelia squarrosa (Pursh.) Dun.	GRSQ1	F	Y					0.3	0.5			0.5	1.2	0.3	0.5
Helianthus annuus L.	HEAN1	F	Y			1.5	2.9	1.8	3.6						
Lesquerella montana (A. Gray) Wats.	LEMO1	F	Y												
Linum perenne L. var. lewisii (Pursh.) Eat. & Wright	LIPE1	F	Y											8.5	15.7
Liatris punctata Hook.	LIPU1	F	Y												
Mirabilis linearis (Pursh.) Heimerl	MILI1	F	Y												
Onosmodium molle Michx. var. occidentale (Mack.) Johnst.	ONMO1	F	Y												
Plantago patagonica Jacq.	PLPA1	F	Y			0.3	0.5			0.3	0.7				
Psoralea tenuiflora Pursh.	PSTE1	F	Y												
Solanum rostratum Dun.	SORO1	F	Y												
Sphaeralcea coccinea (Pursh.) Rydb.	SPCO1	F	Y												
Thelesperma megapotanicum (Spreng.) O. Ktze.	THME1	F	Y											0.3	0.5
Verbena bracteata Lag. & Rodr.	VEBR1	F	Y			1.5	2.9	4.3	8.8	8.3	21.7	4.7	10.9		
Aegilops cylindrica Host	AECY1	G	N	C	X										
Agropyron cristatum (L.) Gaertn.	AGCR1	G	N	C											
Agropyron intermedium (Host) Beauv.	AGIN1	G	N	C		0.3	0.5								
Bromus inermis Leyss. ssp. inermis	BRIN1	G	N	C										2.3	4.1
Bromus japonicus Thunb. ex Murr.	BRJA1	G	N	C		0.3	0.5					0.2	0.4	0.3	0.5
Bromus tectorum L.	BRTE1	G	N	C	X	1.0	1.9	1.8	3.6			0.2	0.4	0.5	0.9
Festuca pratensis Huds.	FEPR1	G	N	C								1.3	3.1		
Poa compressa L.	POCO1	G	N	C								0.7	1.6	1.8	3.2
Poa pratensis L.	POPR1	G	N	C										0.3	0.5
Triticum aestivum L.	TRAE1	G	N	C		5.8	11.1								
Digitaria sanguinalis (L.) Scop.	DISA1	G	N	W		0.3	0.5								
Echinochloa crusgallii (L.) Beauv.	ECCR1	G	N	W											
Setaria viridis (L.) Beauv.	SEVI1	G	N	W				2.3	4.6						
Agropyron caninum (L.) Beauv. ssp. majus (Vasey) C. L. Hitchc.	AGCA1	G	Y	C		2.8	5.3	4.3	8.8	5.8	15.1	21.2	49.2	1.8	3.2
Agropyron dasystachyum (Hook.) Scribn.	AGDA1	G	Y	C				1.5	3.1						
Agropyron smithii Rydb.	AGSM1	G	Y	C		1.5	2.9	2.3	4.6	2.5	6.6	3.0	7.0	12.3	22.6
Elymus canadensis L.	ELCA1	G	Y	C											
Hordeum jubatum L.	HOJU1	G	Y	C								0.2	0.4		
Hordeum pusillum Nutt.	HOPU1	G	Y	C											
Koeleria pyramidata (Lam.) Beauv.	KOPY1	G	Y	C				0.3	0.5			0.2	0.4		
Stipa comata Trin. & Rupr.	STCO1	G	Y	C										0.3	0.5
Stipa viridula Trin.	STVI1	G	Y	C											
Andropogon gerardii Vitman	ANGE1	G	Y	W				0.8	1.5	2.3	5.9	3.0	7.0		
Andropogon scoparius Michx.	ANSC1	G	Y	W								0.2	0.4		
Bouteloua curtipendula (Michx.) Torr.	BOCU1	G	Y	W		1.5	2.9	3.8	7.7	0.8	2.0	0.7	1.6		
Bouteloua gracilis (H. B. K.) Lag ex Griffiths	BOGR1	G	Y	W		0.3	0.5	2.8	5.7	3.5	9.2			6.8	12.4
Buchloe dactyloides (Nutt.) Engelm.	BUDA1	G	Y	W				2.3	4.6	0.8	2.0	1.2	2.7		

Table 6−13 (continued). Species Foliar Cover Summary at Locations A16−A20

Scientific Name	Speccode	Growth Form	Native	Cool/ Warm Season	Noxious Weed	A16		A17		A18		A19		A20	
						Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)
Muhlenbergia montana (Nutt.) Hitchc.	MUMO1	G	Y	W											
Sorghastrum nutans (L.) Nash	SONU1	G	Y	W				0.3	0.5						
Sporobolus asper (Michx.) Kunth	SPAS1	G	Y	W											
Sporobolus cryptandrus (Torr.) A. Gray	SPCR1	G	Y	W				0.3	0.5	0.3	0.7				
Unknown species	UNKN							0.3	0.5	0.3	0.7			1.5	2.8
Total Foliar Cover						51.8	100.0	48.5	100.0	38.0	100.0	43.0	100.0	54.3	100.0
Total Forb Cover						38.3	73.9	26.0	53.6	22.0	57.9	11.2	26.0	26.8	49.3
Total Non-Native Forb Cover						34.8	67.1	17.5	36.1	13.0	34.2	6.0	14.0	6.5	12.0
Total Native Forb Cover						3.5	6.8	8.5	17.5	9.0	23.7	5.2	12.0	20.3	37.3
Total Graminoid Cover						13.5	26.1	22.3	45.9	15.8	41.4	31.8	74.0	26.0	47.9
Total Non-Native Graminoid Cover						7.5	14.5	4.0	8.2	0.0	0.0	2.3	5.4	5.0	9.2
Total Native Graminoid Cover						6.0	11.6	18.3	37.6	15.8	41.4	29.5	68.6	21.0	38.7
Total Native Cover						9.5	18.4	26.8	55.2	24.8	65.1	34.7	80.6	41.3	76.0
Total Non-Native Cover						42.3	81.6	21.5	44.3	13.0	34.2	8.3	19.4	11.5	21.2
Total Warm-Season Graminoid Cover						2.0	3.9	12.3	25.3	7.5	19.7	5.0	11.6	6.8	12.4
Total Cool-Season Graminoid Cover						11.5	22.2	10.0	20.6	8.3	21.7	26.8	62.4	19.3	35.5
Total Noxious Weed Cover						10.8	20.8	10.8	22.2	4.3	11.2	3.2	7.4	4.0	7.4

Absolute Cover = The percentage of the number of hits on a species out of the total number of hits possible.
Relative Cover = The percentage of the number of hits on a species out of the total number of vegetation hits.
Native Categories: Y = Native, N = Non-Native
Growth Form Categories: F = Forb, G = Graminoid
Cool/Warm Season Categories: C = Cool-Season Graminoid, W = Warm-Season Graminoid
Noxious Weed Category: X = Noxious Weed (listed on May 2006 Colorado State Noxious Weed List)
Shaded cells indicate success criteria were met in 2006.

Table 6−14. Species Foliar Cover Summary at Locations A21−A25

Scientific Name	Speccode	Growth Form	Native	Cool/ Warm Season	Noxious Weed	A21		A22		A23		A24		A25	
						Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)
Alyssum alyssoides (L.) L.	ALAL1	F	N			0.1	0.2								
Alyssum minus (L.) Rothmaler var. micranthus (C. A. Mey.) Dudley	ALMI1	F	N					0.2	0.4					0.2	0.8
Amaranthus albus L.	AMAL2	F	N												
Carduus nutans L. ssp. macrolepis (Peterm.) Kazmi	CANU1	F	N		X			0.1	0.2						
Centaurea diffusa Lam.	CEDI1	F	N		X	1.8	4.1	2.8	6.5	0.5	1.9			1.0	5.0
Chenopodium album L.	CHAL1	F	N			0.1	0.2								
Chrysanthemum leucanthemum L.	CHLE1	F	N		X										
Cirsium arvense (L.) Scop.	CIAR1	F	N		X	2.3	5.2	4.3	9.9					0.1	0.4
Convolvulus arvensis L.	COAR1	F	N		X	2.7	6.2	0.8	1.7						
Dyssodia papposa (Vent) Hitchc.	DYPA1	F	N												
Erodium cicutarium (L.) L'Her.	ERCI1	F	N		X	1.3	3.1	0.1	0.2					0.6	2.9
Kochia scoparia (L.) Schrad.	KOSC1	F	N			5.5	12.7	0.2	0.4					0.7	3.3
Lactuca serriola L.	LASE1	F	N			2.8	6.6	0.8	1.7	1.8	6.6			1.6	7.9
Lepidium campestre (L.) R. Br.	LECA1	F	N							0.5	1.9				
Linaria dalmatica (L.) Mill.	LIDA1	F	N		X			0.1	0.2						
Marrubium vulgare L.	MAVU1	F	N												
Melilotus alba Medic.	MEAL1	F	N			2.5	5.8								
Medicago lupulina L.	MELU1	F	N												
Melilotus officinalis (L.) Pall.	MEOF1	F	N			5.6	12.9	3.1	7.1					1.3	6.2
Medicago sativa L. ssp. sativa	MESA1	F	N												
Plantago lanceolata L.	PLLA1	F	N			0.1	0.2	0.1	0.2						
Polygonum arenastrum Jord. ex Bor.	POAR1	F	N			0.3	0.6								
Polygonum persicaria L.	POPE2	F	N												
Rumex crispus L.	RUCR1	F	N												
Salsola iberica Senn. & Pau.	SAIB1	F	N			0.5	1.2	0.3	0.6					0.7	3.3
Scorzonera laciniata L.	SCLA1	F	N			0.1	0.2								
Sisymbrium altissimum L.	SIAL1	F	N												
Sonchus arvensis L. ssp. uglinosus (Bieb.) Nyman	SOAR2	F	N												
Taraxacum officinale Weber	TAOF1	F	N												
Tragopogon dubius Scop.	TRDU1	F	N			0.1	0.2	0.2	0.4			0.3	0.4		
Verbascum thapsus L.	VETH1	F	N		X			0.8	1.7						
Ambrosia artemisiifolia L.	AMAR1	F	Y			0.1	0.2								
Ambrosia psilostachya DC.	AMPS1	F	Y			0.7	1.5	0.1	0.2	1.8	6.6				
Artemisia campestris L. ssp. caudata (Michx.) Hall & Clem.	ARCA1	F	Y												
Artemisia frigida Willd.	ARFR1	F	Y												
Astragalus canadensis L.	ASCA1	F	Y												
Aster porteri Gray	ASPO1	F	Y												
Asclepias speciosa Torr.	ASSP1	F	Y					0.2	0.4						
Chenopodium fremontii S. Wats.	CHFR1	F	Y			0.1	0.2								
Chrysopsis fulcrata Greene	CHFU1	F	Y					0.5	1.1						
Chenopodium leptophyllum Nutt. ex Moq.	CHLE2	F	Y												
Conyza canadensis (L.) Cronq.	COCA1	F	Y							0.3	0.9				

Table 6−14 (continued). Species Foliar Cover Summary at Locations A21−A25

Scientific Name	Speccode	Growth Form	Native	Cool/ Warm Season	Noxious Weed	A21		A22		A23		A24		A25	
						Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)
Comandra umbellata (L.) Nutt.	COUM1	F	Y												
Erysimum capitatum (Nutt.) DC.	ERCA2	F	Y												
Erigeron divergens T. & G.	ERDI1	F	Y					0.1	0.2						
Euphorbia serpyllifolia Pers.	EUSE1	F	Y					0.1	0.2						
Grindelia squarrosa (Pursh.) Dun.	GRSQ1	F	Y			0.6	1.4	0.7	1.5	1.5	5.7				
Helianthus annuus L.	HEAN1	F	Y			0.5	1.2								
Lesquerella montana (A. Gray) Wats.	LEMO1	F	Y												
Linum perenne L. var. lewisii (Pursh.) Eat. & Wright	LIPE1	F	Y					0.2	0.4						
Liatris punctata Hook.	LIPU1	F	Y												
Mirabilis linearis (Pursh.) Heimerl	MILI1	F	Y												
Onosmodium molle Michx. var. occidentale (Mack.) Johnst.	ONMO1	F	Y					0.1	0.2						
Plantago patagonica Jacq.	PLPA1	F	Y												
Psoralea tenuiflora Pursh.	PSTE1	F	Y					0.6	1.3						
Solanum rostratum Dun.	SORO1	F	Y												
Sphaeralcea coccinea (Pursh.) Rydb.	SPCO1	F	Y					0.5	1.1						
Thelesperma megapotanicum (Spreng.) O. Ktze.	THME1	F	Y												
Verbena bracteata Lag. & Rodr.	VEBR1	F	Y			0.3	0.6	0.6	1.3						
Aegilops cylindrica Host	AECY1	G	N	C	X			0.1	0.2					0.6	2.9
Agropyron cristatum (L.) Gaertn.	AGCR1	G	N	C		0.1	0.2								
Agropyron intermedium (Host) Beauv.	AGIN1	G	N	C								9.3	13.5		
Bromus inermis Leyss. ssp. inermis	BRIN1	G	N	C		0.3	0.6	2.7	6.1						
Bromus japonicus Thunb. ex Murr.	BRJA1	G	N	C				0.3	0.8						
Bromus tectorum L.	BRTE1	G	N	C	X	0.2	0.4	1.0	2.3			15.5	22.6	0.7	3.3
Festuca pratensis Huds.	FEPR1	G	N	C				0.1	0.2						
Poa compressa L.	POCO1	G	N	C											
Poa pratensis L.	POPR1	G	N	C		0.1	0.2								
Triticum aestivum L.	TRAE1	G	N	C				0.1	0.2					2.6	12.8
Digitaria sanguinalis (L.) Scop.	DISA1	G	N	W											
Echinochloa crusgallii (L.) Beauv.	ECCR1	G	N	W											
Setaria viridis (L.) Beauv.	SEVI1	G	N	W											
Agropyron caninum (L.) Beauv. ssp. majus (Vasey) C. L. Hitchc.	AGCA1	G	Y	C		8.9	20.7	9.0	20.7	7.8	29.2	0.3	0.4	6.4	31.8
Agropyron dasystachyum (Hook.) Scribn.	AGDA1	G	Y	C											
Agropyron smithii Rydb.	AGSM1	G	Y	C		1.8	4.2	2.4	5.5	6.5	24.5	15.3	22.3	3.2	15.7
Elymus canadensis L.	ELCA1	G	Y	C											
Hordeum jubatum L.	HOJU1	G	Y	C		0.1	0.2								
Hordeum pusillum Nutt.	HOPU1	G	Y	C											
Koeleria pyramidata (Lam.) Beauv.	KOPY1	G	Y	C											
Stipa comata Trin. & Rupr.	STCO1	G	Y	C											
Stipa viridula Trin.	STVI1	G	Y	C				0.5	1.1			20.5	29.9		
Andropogon gerardii Vitman	ANGE1	G	Y	W		0.3	0.6	0.6	1.3						
Andropogon scoparius Michx.	ANSC1	G	Y	W											
Bouteloua curtipendula (Michx.) Torr.	BOCU1	G	Y	W		2.2	5.0	4.8	10.9	3.0	11.3	0.3	0.4	0.5	2.5
Bouteloua gracilis (H. B. K.) Lag ex Griffiths	BOGR1	G	Y	W		0.9	2.1	0.7	1.5	3.0	11.3	1.5	2.2	0.3	1.2
Buchloe dactyloides (Nutt.) Engelm.	BUDA1	G	Y	W		0.7	1.5	2.3	5.2			2.0	2.9		

Table 6−14 (continued). Species Foliar Cover Summary at Locations A21−A25

Scientific Name	Speccode	Growth Form	Native	Cool/ Warm Season	Noxious Weed	A21		A22		A23		A24		A25	
						Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)
Muhlenbergia montana (Nutt.) Hitchc.	MUMO1	G	Y	W											
Sorghastrum nutans (L.) Nash	SONU1	G	Y	W											
Sporobolus asper (Michx.) Kunth	SPAS1	G	Y	W				2.1	4.8			3.8	5.5		
Sporobolus cryptandrus (Torr.) A. Gray	SPCR1	G	Y	W											
Unknown species	UNKN														
Total Foliar Cover						43.2	100.0	43.6	100.0	26.5	100.0	68.5	100.0	20.2	100.0
Total Forb Cover						27.8	64.3	17.1	39.2	6.3	23.6	0.3	0.4	6.0	29.8
Total Non-Native Forb Cover						25.6	59.3	13.6	31.2	2.8	10.4	0.3	0.4	6.0	29.8
Total Native Forb Cover						2.2	5.0	3.5	8.0	3.5	13.2	0.0	0.0	0.0	0.0
Total Graminoid Cover						15.4	35.7	26.5	60.8	20.3	76.4	68.3	99.6	14.2	70.2
Total Non-Native Graminoid Cover						0.6	1.4	4.3	9.8	0.0	0.0	24.8	36.1	3.8	19.0
Total Native Graminoid Cover						14.8	34.4	22.3	51.1	20.3	76.4	43.5	63.5	10.3	51.2
Total Native Cover						17.0	39.4	25.8	59.1	23.8	89.6	43.5	63.5	10.3	51.2
Total Non-Native Cover						26.2	60.6	17.8	40.9	2.8	10.4	25.0	36.5	9.8	48.8
Total Warm-Season Graminoid Cover						4.0	9.3	10.3	23.7	6.0	22.6	7.5	10.9	0.8	3.7
Total Cool-Season Graminoid Cover						11.4	26.4	16.2	37.1	14.3	53.8	60.8	88.7	13.4	66.5
Total Noxious Weed Cover						8.2	18.9	10.0	22.9	0.5	1.9	15.5	22.6	2.9	14.5

Absolute Cover = The percentage of the number of hits on a species out of the total number of hits possible.
Relative Cover = The percentage of the number of hits on a species out of the total number of vegetation hits.
Native Categories: Y = Native, N = Non-Native
Growth Form Categories: F = Forb, G = Graminoid
Cool/Warm Season Categories: C = Cool-Season Graminoid, W = Warm-Season Graminoid
Noxious Weed Category: X = Noxious Weed (listed on May 2006 Colorado State Noxious Weed List)
Shaded cells indicate success criteria were met in 2006.

This page intentionally left blank

Table 6−15 presents a summary of the pass/fail criteria for each revegetation location monitored in 2006. Eight of the locations passed all four criteria in 2006. It is not unexpected that most failed at this point in time, as it often takes 5 or 6 years to establish a good stand of vegetation. It should also be remembered that the success criteria listed in the Revegetation Plan are an initial set of criteria established primarily for erosion protection. As stated in the Revegetation Plan, these "...criteria are provided as initial guidance; however, common sense combined with scientific data will need to be applied to final evaluations to determine whether further management actions are required at specific locations" (DOE 2005c). It should also be noted that the success criteria listed in the Revegetation Plan were taken from the Rocky Mountain Arsenal (RMA) National Wildlife Refuge Habitat Restoration Plan (USFWS 1999) and are the criteria that is used at the RMA. So although some of the areas passed each of the criteria listed in the Revegetation Plan, this does not mean that the vegetation has established to a desirable level at these locations as of 2006. Some of the revegetation locations may require some reseeding and weed control also. The drought experienced in 2006 also limited the amount of vegetation growth observed this year. Normal precipitation amounts should result in increased vegetation growth in future years. Proactive management of the revegetation areas is critical to success. These data provide useful information for making management decisions and provide documentation of the successional changes at the revegetation locations that can then be used to help improve revegetation techniques at the Site.

6.2.4 Present Landfill/Original Landfill Monitoring

As part of the cleanup and closure of the Site, two landfills were covered using different types for covers. At the PLF, a RCRA Subtitle C-compliant cover was constructed to protect the underlying waste. At the OLF, a 2-foot-thick soil cover was placed over the waste material. Both areas were seeded with native plant species to provide a vegetation cover on each landfill. As part of the revegetation process, monitoring is conducted to evaluate the status of the vegetation. The Rocky Flats, Colorado, Site Revegetation Plan (Revegetation Plan; DOE 2005c) provides initial success criteria for revegetation areas at the Site. As stated in the plan the success criteria contained in the Revegetation Plan are simply initial guidance and may be modified using professional judgment, scientific data, and common sense to determine whether the vegetation establishment at a given location is acceptable for the specific location(s). This report summarizes the revegetation monitoring results for data collected at the PLF and OLF during 2006.

Semi-quantitative revegetation monitoring was conducted during late summer to evaluate the establishment of vegetation at the PLF and OLF in 2006. The PLF was divided into three revegetation sampling units, two on the cover and one on the east face (Figure 6–7). The OLF was sampled as one unit (Figure 6–7). Within each revegetation unit, sample locations were randomly generated in the GIS and then located on the ground using a GPS for monitoring. Quadrats (0.5 m2; 50 cm × 100 cm) were used to sample the vegetation. A total of 15 quadrats were sampled on each half of the cover at the PLF, with an additional 10 quadrats sampled on the east face of the PLF. The top of the cover was roughly split in half because the eastern and western areas differed somewhat in the soil materials that were placed on each half. So the sampling was designed to see if there was a difference in the vegetation. The OLF had a total of 30 quadrats sampled across the face of the cover. At each quadrat, both species richness and species cover were sampled.

Table 6−15. Success Criteria Summary for Revegetation Locations in 2006

Location	Minimum of 50% of Seeded Species Present	70% Ground Cover of Litter, Rock, and Vegetation	30% Relative Cover of Desired Species	No Single Species With >45% Relative Cover	Overall Pass/Fail
A1	Fail	Fail	Fail	Pass	Fail
A2	Fail	Fail	Fail	Pass	Fail
A3	Fail	Pass	Pass	Pass	Fail
A4	Pass	Pass	Pass	Pass	Pass
A5	Fail	Fail	Fail	Pass	Fail
A6	Pass	Fail	Pass	Pass	Fail
A7	Fail	Fail	Pass	Pass	Fail
A8	Pass	Pass	Pass	Pass	Pass
A9	Fail	Fail	Pass	Pass	Fail
A10	Pass	Pass	Pass	Fail	Fail
A11	Fail	Fail	Fail	Pass	Fail
A12	Fail	Fail	Fail	Pass	Fail
A13	Fail	Pass	Pass	Pass	Fail
A14	Pass	Fail	Pass	Pass	Fail
A15	Pass	Pass	Pass	Pass	Pass
A16	Fail	Pass	Fail	Pass	Fail
A17	Pass	Pass	Pass	Pass	Pass
A18	Pass	Fail	Pass	Pass	Fail
A19	Pass	Pass	Pass	Fail	Fail
A20	Fail	Pass	Pass	Pass	Fail
A21	Pass	Fail	Pass	Pass	Fail
A22	Pass	Pass	Pass	Pass	Pass
A23	Pass	Pass	Pass	Pass	Pass
A24	Pass	Pass	Pass	Pass	Pass
A25	Pass	Pass	Pass	Pass	Pass

Notes: Shaded locations pass success criteria in 2006.

Species richness in 2006 at both the PLF and OLF is presented in Table 6−16. Total species richness at the PLF was 35 species in 2006, while the OLF had 15 species. Much of this is related to the fact that 2006 was the second growing season for the PLF, while 2006 was really the first growing season for the OLF since the projects were completed. Additionally, the drought in 2006 limited germination and establishment on the south-facing OLF. At the PLF, a total of eight seed species were present in 2006. Table 6−17 lists the species that were seeded at each landfill. At the OLF, a total of four seeded species were present in 2006. One of the success criteria in the Revegetation Plan (DOE 2005c) states that at least 50 percent of the seeded species must be present in an area for it to be considered successful. Table 6−18 lists the location, number of seeded species, number of species present at the location, and percentage present at each location in 2006. All four sampled areas on the landfills met this criteria in 2006.

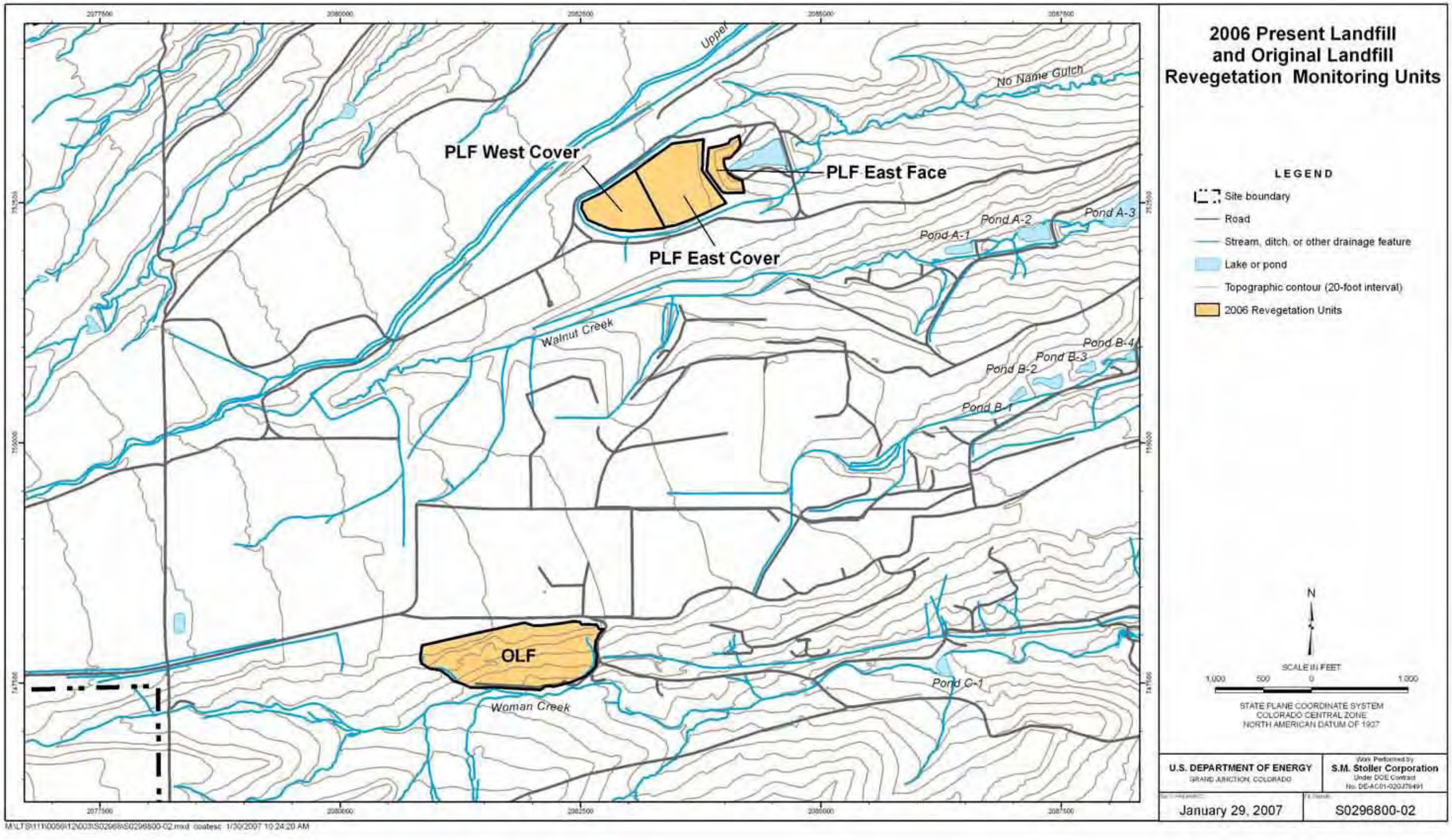


Figure 6–7. 2006 Present Landfill and Original Landfill Revegetation Monitoring Units

This page intentionally left blank

Table 6−16. 2006 Species Richness Summary at the PLF and OLF

Family	Scientific Name	Speccode	Native	Noxious Weed	PLF East Cover	PLF West Cover	PLF East Face	OLF
ASTERACEAE	Ambrosia psilostachya DC.	AMPS1	Y				X	
ASTERACEAE	Aster porteri Gray	ASPO1	Y		X			
ASTERACEAE	Carduus nutans L. ssp. macrolepis (Peterm.) Kazmi	CANU1	N	X				
ASTERACEAE	Centaurea diffusa Lam.	CEDI1	N	X	X	X	X	X
ASTERACEAE	Chrysanthemum leucanthemum L.	CHLE1	N	X				
ASTERACEAE	Cirsium arvense (L.) Scop.	CIAR1	N	X				X
ASTERACEAE	Conyza canadensis (L.) Cronq.	COCA1	Y		X		X	
ASTERACEAE	Grindelia squarrosa (Pursh.) Dun.	GRSQ1	Y		X	X	X	
ASTERACEAE	Lactuca serriola L.	LASE1	N		X	X	X	X
ASTERACEAE	Taraxacum officinale Weber	TAOF1	N		X	X		
ASTERACEAE	Tragopogon dubius Scop.	TRDU1	N			X		
BRASSICACEAE	Alyssum minus (L.) Rothmaler var. micranthus (C. A. Mey.) Dudley	ALMI1	N					X
BRASSICACEAE	Lepidium campestre (L.) R. Br.	LECA1	N		X	X	X	
CHENOPODIACEAE	Kochia scoparia (L.) Schrad.	KOSC1	N					X
CHENOPODIACEAE	Salsola iberica Senn. & Pau.	SAIB1	N					X
CONVOLVULACEAE	Convolvulus arvensis L.	COAR1	N	X		X		
FABACEAE	Melilotus alba Medic.	MEAL1	N			X		
FABACEAE	Melilotus officinalis (L.) Pall.	MEOF1	N		X	X		X
GERANIACEAE	Erodium cicutarium (L.) L'Her.	ERCI1	N	X		X		X
PLANTAGINACE	Plantago lanceolata L.	PLLA1	N			X		
POACEAE	Aegilops cylindrica Host	AECY1	N	X				X
POACEAE	Agropyron caninum (L.) Beauv. ssp. majus (Vasey) C. L. Hitchc.	AGCA1	Y		X	X	X	X
POACEAE	Agropyron smithii Rydb.	AGSM1	Y		X	X	X	X
POACEAE	Andropogon gerardii Vitman	ANGE1	Y		X	X		
POACEAE	Andropogon scoparius Michx.	ANSC1	Y		X	X		
POACEAE	Bouteloua curtipendula (Michx.) Torr.	BOCU1	Y		X	X	X	X
POACEAE	Bouteloua gracilis (H. B. K.) Lag ex Griffiths	BOGR1	Y		X		X	X
POACEAE	Bromus japonicus Thunb. ex Murr.	BRJA1	N			X		

Table 6−16 (continued). 2006 Species Richness Summary at the PLF and OLF

Family	Scientific Name	Speccode	Native	Noxious Weed	PLF East Cover	PLF West Cover	PLF East Face	OLF
POACEAE	Bromus tectorum L.	BRTE1	N	X	X	X		X
POACEAE	Buchloe dactyloides (Nutt.) Engelm.	BUDA1	Y		X	X		
POACEAE	Festuca pratensis Huds.	FEPR1	N			X		
POACEAE	Hordeum jubatum L.	HOJU1	Y			X		
POACEAE	Koeleria pyramidata (Lam.) Beauv.	KOPY1	Y			X		
POACEAE	Poa compressa L.	POCO1	N		X	X		
POACEAE	Triticum aestivum L.	TRAE1	N					X
SANTALACEAE	Comandra umbellata (L.) Nutt.	COUM1	Y		X			
SCROPHULARIACEAE	Linaria dalmatica (L.) Mill.	LIDA1	N	X				
SCROPHULARIACEAE	Verbascum thapsus L.	VETH1	N	X		X		
VERBENACEAE	Verbena bracteata Lag. & Rodr.	VEBR1	Y		X	X		
	Unknown species	UNKN						
		Total Number of Species			19	25	10	15
		Grand Total			35		15	

Table 6−17. Seeded Species By Location

Family	Scientific Name	PLF	OLF
Graminoids			
POACEAE	Agropyron caninum	X	X
POACEAE	Agropyron dasystachum	X	X
POACEAE	Agropyron lanceolatus	X	
POACEAE	Agropyron smithii	X	X
POACEAE	Andropogon gerardii	X	
POACEAE	Andropogon scoparius		
POACEAE	Bouteloua curtipendula	X	X
POACEAE	Bouteloua gracilis	X	X
POACEAE	Buchloe dactyloides	X	X
POACEAE	Koleria pyrimidata	X	
POACEAE	Poa canbyi	X	
POACEAE	Sorghastrum nutans	X	
POACEAE	Sporobolus cryptandrus	X	
POACEAE	Stipa viridula	X	X
	Total # Species Seeded	13	7

Table 6−18. Number of Seeded Species Present in 2006 Summary

Location	# Species Seeded at Location	# Seeded Species Present in 2006	% Seeded Species Present in 2006
PLF East Cover	13	7	54
PLF West Cover	13	7	54
PLF East Face	7	4	57
OLF	7	4	57

Notes: Shaded locations pass success criteria in 2006.

Ground cover protection from rock, litter, and current year live vegetation was above 95 percent at both the PLF and OLF (Table 6−19). The occasional value over 100 percent is a result of the cover class system used for estimating cover which estimates cover values into a range and uses the midpoint of the cover class for analysis. Another success criterion outlined in the Revegetation Plan (DOE 2005c), states a minimum of 70 percent total ground cover comprised of litter cover, current year live vegetation basal cover, and rock cover is to be present to help prevent erosion. At each of the locations on the PLF and OLF most of the ground cover came from litter, which at this time represents the erosion matting. In time the litter cover will continue to remain the dominant ground cover but it will come from dead plant material that is matted down, rather from the erosion matting. The bottom line is that at both locations there is substantial protection on the soil surface to prevent erosion.

Table 6−19. 2006 Rock, Litter, and Basal Vegetation Cover Summary

Location	Basal Veg Cover	Rock Cover	Litter Cover	Total Ground Cover
PLF East Cover	2.5	21.0	75.2	98.7
PLF West Cover	3.3	13.3	79.0	95.7
PLF East Face	2.5	9.8	90.0	102.3
OLF	3.1	11.3	85.0	99.3

Notes: All values are percentages.
Some values exceed 100% because of the use of cover class midpoints for data collection and analyses.
Shaded locations pass success criteria in 2006.

A third success criterion outlined in the Revegetation Plan (DOE 2005c), states that a minimum of 30 percent relative cover of desired species must be present and a forth criterion states that no single species comprise more than 45 percent of the total relative cover. Table 6−20 summarizes the foliar cover data for the PLF and OLF by location for 2006. The shaded row titled Total Native Cover represents the percentage of desired species at each location. The relative cover values at individual locations that are higher than 30 percent are shaded, indicating these locations have met this success criterion. This criteria was met at both the PLF and OLF in 2006. Based on actual absolute cover, however, the total actual amount of vegetation cover would have only met at the East and West PLF cover locations with approximately 35 percent cover at each area. The East Face of the PLF and the OLF still had much lower vegetation cover present on them in 2006. The dominant species on the cover of the PLF were slender wheatgrass, side-oats grama (*Bouteloua curtipendula*), big bluestem (*Andropogon gerardii*), and western wheatgrass. The East Face of the PLF was dominated by slender wheatgrass, western wheatgrass, side-oats grama, and blue grama (*Bouteloua gracilis*). Weed cover from forbs on the PLF was not very high in 2006 because most of the top had been treated with Milestone (aminopyralid) in spring of 2006 to keep the weeds down to allow for better establishment of the graminoids. On the OLF, the dominant species were slender wheatgrass, western wheatgrass, and wheat. The relative cover of slender wheatgrass on the West PLF area was above the 45 percent value for a single species. Otherwise no other species comprised greater than 45 percent of the relative cover at either the PLF or OLF.

Table 6−20. 2006 Species Foliar Cover Summary at the PLF and OLF

Scientific Name	Speccode	Growth Form	Native	Cool/ Warm Season	Noxious Weed	PLF East Cover		PLF West Cover		PLF East Face		OLF	
						Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)
Alyssum minus (L.) Rothmaler var. micranthus (C. A. Mey.) Dudley	ALMI1	F	N									0.2	0.8
Centaurea diffusa Lam.	CEDI1	F	N		X	1.0	2.6	1.2	2.7	0.5	1.9	1.0	5.0
Cirsium arvense (L.) Scop.	CIAR1	F	N		X							0.1	0.4
Convolvulus arvensis L.	COAR1	F	N		X			0.2	0.4				
Erodium cicutarium (L.) L'Her.	ERCI1	F	N		X			1.3	3.1			0.6	2.9
Kochia scoparia (L.) Schrad.	KOSC1	F	N									0.7	3.3
Lactuca serriola L.	LASE1	F	N			0.5	1.3	0.8	1.9	1.8	6.6	1.6	7.9
Lepidium campestre (L.) R. Br.	LECA1	F	N			0.2	0.4	0.2	0.4	0.5	1.9		
Melilotus alba Medic.	MEAL1	F	N					0.2	0.4				
Melilotus officinalis (L.) Pall.	MEOF1	F	N			1.3	3.5	1.3	3.1			1.3	6.2
Plantago lanceolata L.	PLLA1	F	N					0.2	0.4				
Salsola iberica Senn. & Pau.	SAIB1	F	N									0.7	3.3
Taraxacum officinale Weber	TAOF1	F	N			0.2	0.4	0.2	0.4				
Tragopogon dubius Scop.	TRDU1	F	N					0.2	0.4				
Verbascum thapsus L.	VETH1	F	N		X			0.3	0.8				
Ambrosia psilostachya DC.	AMPS1	F	Y							1.8	6.6		
Aster porteri Gray	ASPO1	F	Y			0.2	0.4						
Conyza canadensis (L.) Cronq.	COCA1	F	Y			0.5	1.3			0.3	0.9		
Comandra umbellata (L.) Nutt.	COUM1	F	Y			0.2	0.4						
Grindelia squarrosa (Pursh.) Dun.	GRSQ1	F	Y			0.2	0.4	0.5	1.2	1.5	5.7		
Verbena bracteata Lag. & Rodr.	VEBR1	F	Y			2.3	6.1	4.7	10.9				
Aegilops cylindrica Host	AECY1	G	N	C	X							0.6	2.9
Bromus japonicus Thunb. ex Murr.	BRJA1	G	N	C				0.2	0.4				
Bromus tectorum L.	BRTE1	G	N	C	X	0.2	0.4	0.2	0.4			0.7	3.3
Festuca pratensis Huds.	FEPR1	G	N	C				1.3	3.1				
Poa compressa L.	POCO1	G	N	C		0.2	0.4	0.7	1.6				
Triticum aestivum L.	TRAE1	G	N	C								2.6	12.8
Agropyron caninum (L.) Beauv. ssp. majus (Vasey) C. L. Hitchc.	AGCA1	G	Y	C		14.7	38.6	21.2	49.2	7.8	29.2	6.4	31.8
Agropyron smithii Rydb.	AGSM1	G	Y	C		2.2	5.7	3.0	7.0	6.5	24.5	3.2	15.7
Hordeum jubatum L.	HOJU1	G	Y	C				0.2	0.4				
Koeleria pyramidata (Lam.) Beauv.	KOPY1	G	Y	C				0.2	0.4				
Andropogon gerardii Vitman	ANGE1	G	Y	W		5.5	14.5	3.0	7.0				
Andropogon scoparius Michx.	ANSC1	G	Y	W		0.2	0.4	0.2	0.4				
Bouteloua curtipendula (Michx.) Torr.	BOCU1	G	Y	W		6.2	16.2	0.7	1.6	3.0	11.3	0.5	2.5
Bouteloua gracilis (H. B. K.) Lag ex Griffiths	BOGR1	G	Y	W		0.5	1.3			3.0	11.3	0.3	1.2
Buchloe dactyloides (Nutt.) Engelm.	BUDA1	G	Y	W		2.0	5.3	1.2	2.7				
Total Foliar Cover						38.0	100.0	43.0	100.0	26.5	100.0	20.2	100.0
Total Forb Cover						6.5	17.1	11.2	26.0	6.3	23.6	6.0	29.8
Total Non-Native Forb Cover						3.2	8.3	6.0	14.0	2.8	10.4	6.0	29.8
Total Native Forb Cover						3.3	8.8	5.2	12.0	3.5	13.2	0.0	0.0
Total Graminoid Cover						31.5	82.9	31.8	74.0	20.3	76.4	14.2	70.2
Total Non-Native Graminoid Cover						0.3	0.9	2.3	5.4	0.0	0.0	3.8	19.0
Total Native Graminoid Cover						31.2	82.0	29.5	68.6	20.3	76.4	10.3	51.2

Table 6−20 (continued). 2006 Species Foliar Cover Summary at the PLF and OLF

Scientific Name	Speccode	Growth Form	Native	Cool/ Warm Season	Noxious Weed	PLF East Cover		PLF West Cover		PLF East Face		OLF	
						Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)	Absolute Cover (%)	Relative Cover (%)
Total Native Cover						34.5	90.8	34.7	80.6	23.8	89.6	10.3	51.2
Total Non-Native Cover						3.5	9.2	8.3	19.4	2.8	10.4	9.8	48.8
Total Warm-Season Graminoid Cover						14.3	37.7	5.0	11.6	6.0	22.6	0.8	3.7
Total Cool-Season Graminoid Cover						17.2	45.2	26.8	62.4	14.3	53.8	13.4	66.5
Total Noxious Weed Cover						1.2	3.1	3.2	7.4	0.5	1.9	2.9	14.5

Absolute Cover = The percentage of the number of hits on a species out of the total number of hits possible.
Relative Cover = The percentage of the number of hits on a species out of the total number of vegetation hits.
Native Categories: Y = Native, N = Non-Native
Growth Form Categories: F = Forb, G = Graminoid
Cool/Warm Season Categories: C = Cool-Season Graminoid, W = Warm-Season Graminoid
Noxious Weed Category: X = Noxious Weed (listed on May 2006 Colorado State Noxious Weed List)
Shaded cells indicate success criteria were met in 2006.

Table 6−21 presents a summary of the pass/fail criteria for each revegetation areas at the PLF and OLF monitored in 2006. Three of the four locations passed all four criteria in 2006. The only area that did not pass was the East Face of the PLF which had greater than 45 percent cover of slender wheatgrass. An important issue to keep in mind when considering success criteria are that the criteria listed in the Revegetation Plan are an initial set of criteria established primarily for erosion protection. As stated in the Revegetation Plan, these "...criteria are provided as initial guidance; however, common sense combined with scientific data will need to be applied to final evaluations to determine whether further management actions are required at specific locations" (DOE 2005c). It should also be noted that the success criteria listed in the Revegetation Plan were taken from the RMA National Wildlife Refuge Habitat Restoration Plan (USFWS 1999) and are the criteria that is used at the RMA. So although three of the areas passed each of the criteria listed in the Revegetation Plan, this does not mean that the vegetation has established to a desirable level at either landfill as of 2006. Continued management and monitoring to promote a long-term, sustainable, vegetation cover on both landfills will continue to be pursued. A good healthy stand of vegetation is desirable on both landfills to protect the covers and provide good erosion control. Proactive management of the revegetation areas is critical to success. These data provide useful information for making management decisions and provide documentation of the successional changes at the revegetation locations that can then also be used to help improve revegetation techniques at the Site.

Table 6−21. Success Criteria Summary for Revegetation Locations in 2006

Location	Minimum of 50% of Seeded Species Present	70% Ground Cover of Litter, Rock, and Vegetation	30% Relative Cover of Desired Species	No Single Species With >45% Relative Cover	Overall Pass/Fail
PLF East Cover	Pass	Pass	Pass	Pass	Pass
PLF West Cover	Pass	Pass	Pass	Fail	Fail
PLF East Face	Pass	Pass	Pass	Pass	Pass
OLF	Pass	Pass	Pass	Pass	Pass

Notes: Shaded locations pass success criteria in 2006.

6.2.5 Diffuse Knapweed Biological Control Monitoring

Diffuse knapweed is one of the noxious weeds at the Site. A variety of control methods have been used to control diffuse knapweed at the Site, including biological, mechanical, and chemical control methods. Biological control measures are low cost, have a low impact to surrounding habitat and non-target vegetation, and may provide long lasting effects. The effectiveness of biological controls measured for 6 years on diffuse knapweed populations at the Site is evaluated in this report.

Various species of biological control insects have been released on Site for control of diffuse knapweed, including the Lesser knapweed flower weevil (*Larinus minutus*), Blunt knapweed flower weevil (*L. obtusus*), Banded gall fly (*Urophora affinis*), and UV knapweed seed head fly (*U. quadrifasciata*), all of which cause damage to the seeds of the knapweed. The other diffuse knapweed biocontrol insects that have been released and documented on Site (*Cyphocleonus achates* and *Sphenoptera yugoslavica)* cause damage to either roots or stems of the plant.

Objectives of the study include:

- Evaluate changes in pre and post-treatment diffuse knapweed cover and density at the release locations through time.
- Document visually, through photo monitoring, changes in diffuse knapweed populations at the release locations.
- Using flowerhead and seed counts, evaluate biocontrol insect impacts on diffuse knapweed seed production.

Figure 6–8 shows the release locations of the *L. minutus* weevils. The biocontrol insects at release sites one through five were released in 2001. Insects at release site six were released in 2002. Release location number five (label shown in grey on Figure 6–8) was removed from the study in 2004 because the area was treated with herbicides. Location LM6 was established in 2002, therefore, there are no cover or density data prior to 2002 for this location. When making comparisons between years for the density and cover data, the mean includes data from all locations sampled during a specific year.

The overall mean cover of diffuse knapweed plants at the five locations sampled in 2006 was 0.6 percent. For years 2001 through 2005 the mean cover for all locations sampled in that specific year was 21.4 percent, 12.7 percent, 15.4 percent, 13.0 percent and 12.8 percent, respectively (Table 6−22). Cover for 2006 was significantly lower than 2001 and 2003 ($p = 0.009$). Percent cover of diffuse knapweed decreased in 2006 at all locations from the previous years 2001 to 2005 (Figure 6–9). There was no significant difference found when comparing the 2006 cover results between the five biocontrol locations.

Table 6−22. Average Percent Cover of Diffuse Knapweed at Biocontrol Release Locations (2001−2006)

Location	2001	2002	2003	2004	2005	2006
LM1	33.5	15.9	12.7	14.1	11.7	0
LM2	19.4	6.0	19.2	11.7	6.8	1.5
LM3	21.6	12.3	9.2	1.8	3.3	0.3
LM4	26.1	10.4	22.0	23.8	32.1	1.2
LM5	6.3	14.5	24.1	N/A	N/A	N/A
LM6	N/A	17.1	5.4	13.8	10.1	0
Mean	21.4	12.7	15.4	13.0	12.8	0.6

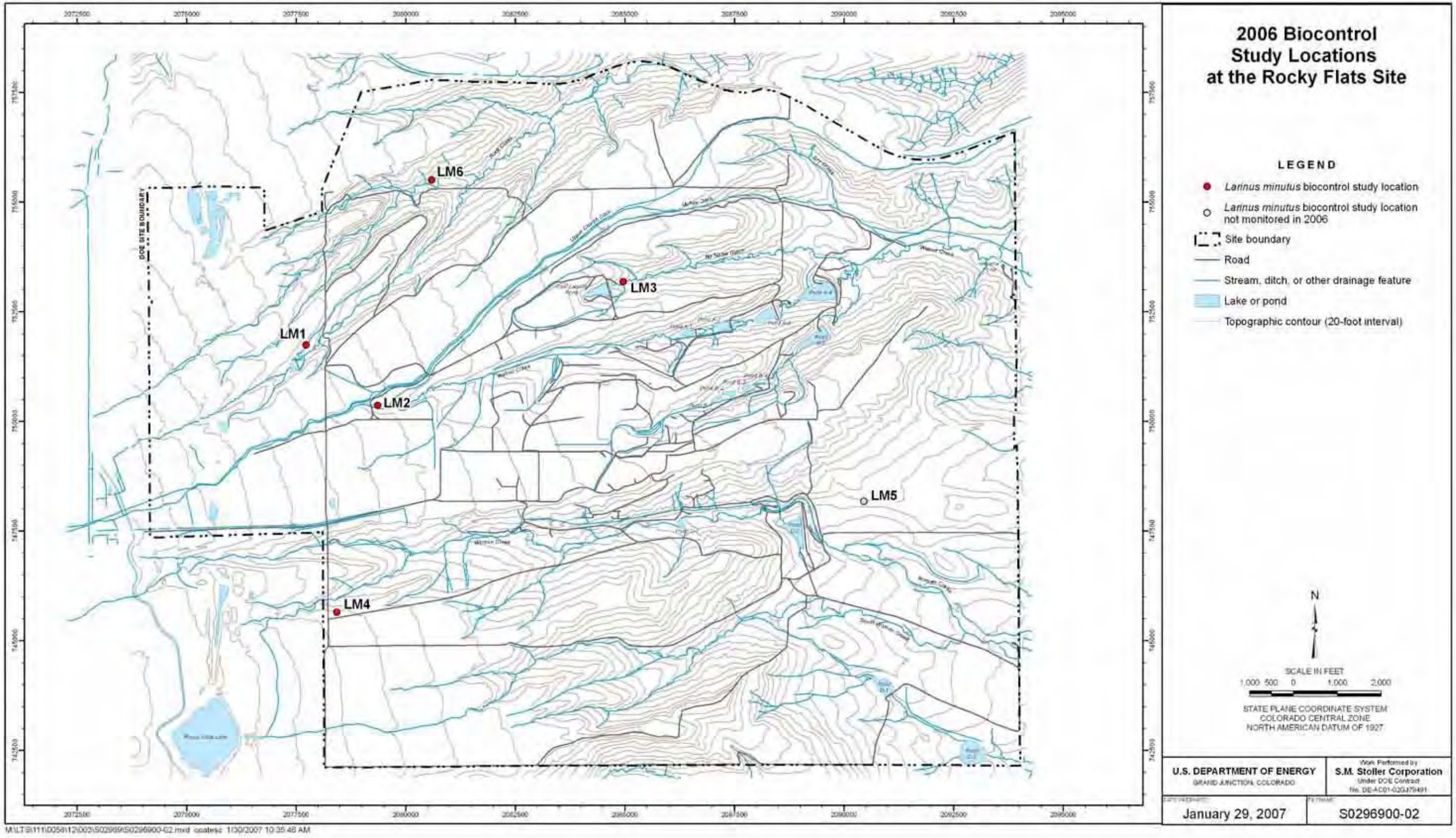
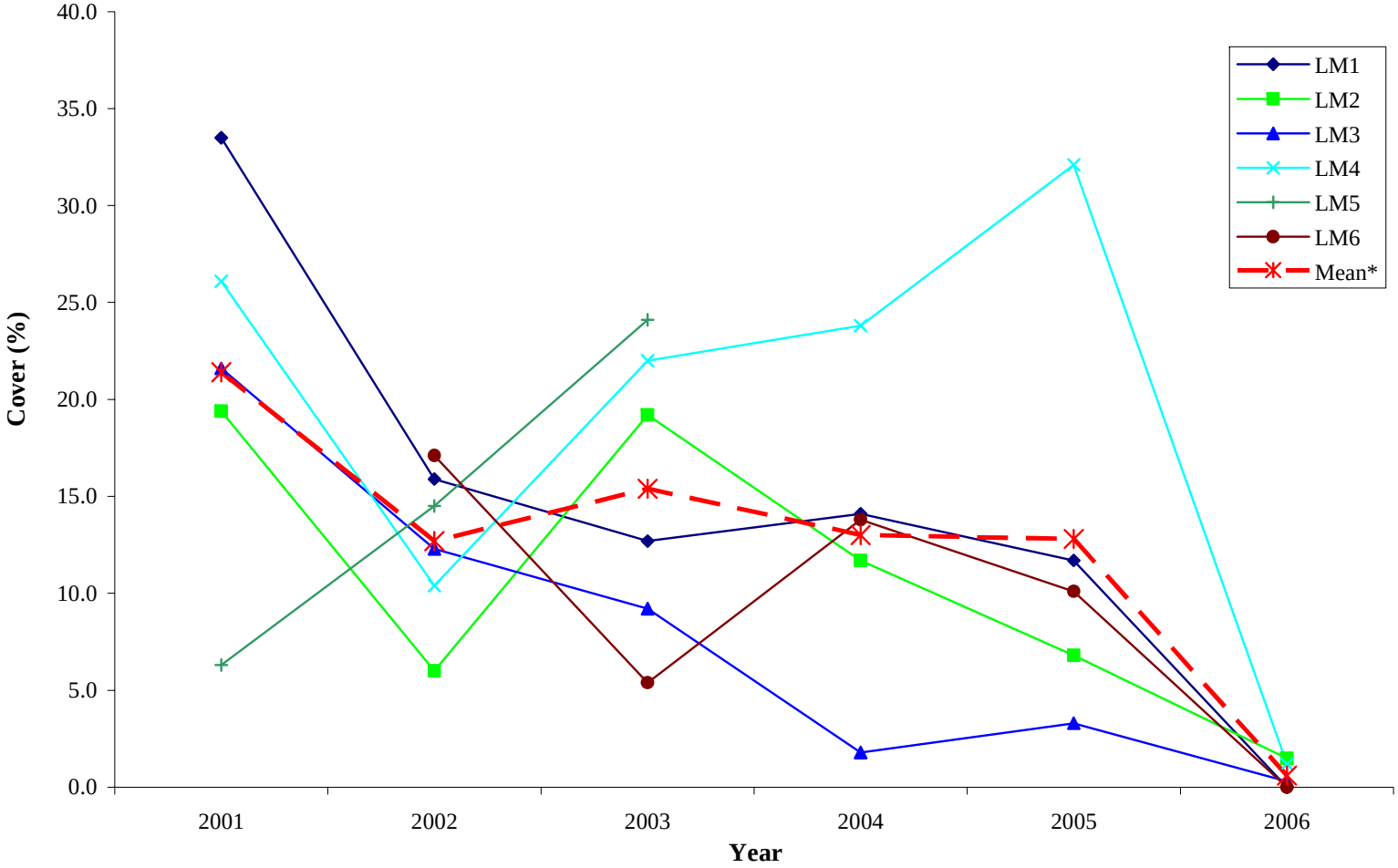


Figure 6–8. 2006 Biocontrol Study Locations at the Rocky Flats Site

This page intentionally left blank



*The mean includes data from all locations sampled during a specific year.

Figure 6–9. Diffuse Knapweed Cover at Biocontrol Release Locations (2001−2006)

The overall mean density of diffuse knapweed plants at the five locations sampled in 2006 was 0.6 plants per square meter. From 2001 through 2005, the mean density for all locations sampled in each specific year was 9.1, 7.1, 3.0, 4.9 and 12.2 plants per square meter respectively (Table 6−23). Density was significantly lower in 2006 than in 2005 ($p = 0.012$). In 2006, the overall mean density was the lowest it had been since the initiation of the study.

Table 6−23. Average Density (plants/m^2) of Diffuse Knapweed Plants at Biocontrol Release Locations (2001−2006)

Location	2001	2002	2003	2004	2005	2006
LM1	15.8	7.8	4.6	6.0	7.8	0
LM2	14.5	3.9	5.0	4.3	7.3	0.8
LM3	4.4	8.0	1.2	0.5	1.5	0.3
LM4	9.5	3.3	4.5	8.9	27.5	1.8
LM5	1.1	6.8	2.4	N/A	N/A	N/A
LM6	N/A	12.6	0.5	4.6	16.8	0
Mean	9.1	7.1	3.0	4.9	12.2	0.6

In past years, the density data have fluctuated (with the density at some sample locations increasing, while at others decreasing). In 2005 densities at all individual locations increased from 2004, but decreased again in 2006 (Figure 6–10). Comparing only the 2006 density results between the five locations, there were no significant differences found.

6.2.5.1 Flowerhead Counts

The mean number of flowerheads per plant at all five locations monitored in 2006 was 169 flowerheads per plant. From 2001 through 2005, the mean number of flowerheads per plant has been 153, 135, 288, 454, and 251, respectively (Table 6−24). The mean number of flowerheads per plant doubled from 2002 to 2003 (statistically significant increase, $p = 0.002$), then increased again from 2003 to 2004 (no statistical significance). The year 2004 was significantly higher in flowerhead counts compared to 2001 and 2002 ($p = 0.002$). In 2005, the mean number of flowerheads per plant decreased to about half the number in 2004 (statistically significant decrease, $p = 0.040$). The mean number of flowerheads per plant in 2006 was slightly higher than at the beginning of the study in 2001, but less than 2003 through 2005 (Figure 6–11). Between locations in 2006, location LM2 had significantly higher flowerhead counts compared to LM1, LM3, and LM6 ($p < 0.001$).

Table 6−24. The Average Number of Flowerheads per Plant at Biocontrol Release Locations (2001−2006)

Location	2001	2002	2003	2004	2005	2006
LM1	152	126	219	664	278	102
LM2	84	87	246	215	240	263
LM3	140	123	318	397	140	158
LM4	145	161	165	506	372	199
LM5	200	158	521	N/A	N/A	N/A
LM6	196	157	260	486	227	125
Mean	153	135	288	454	251	169

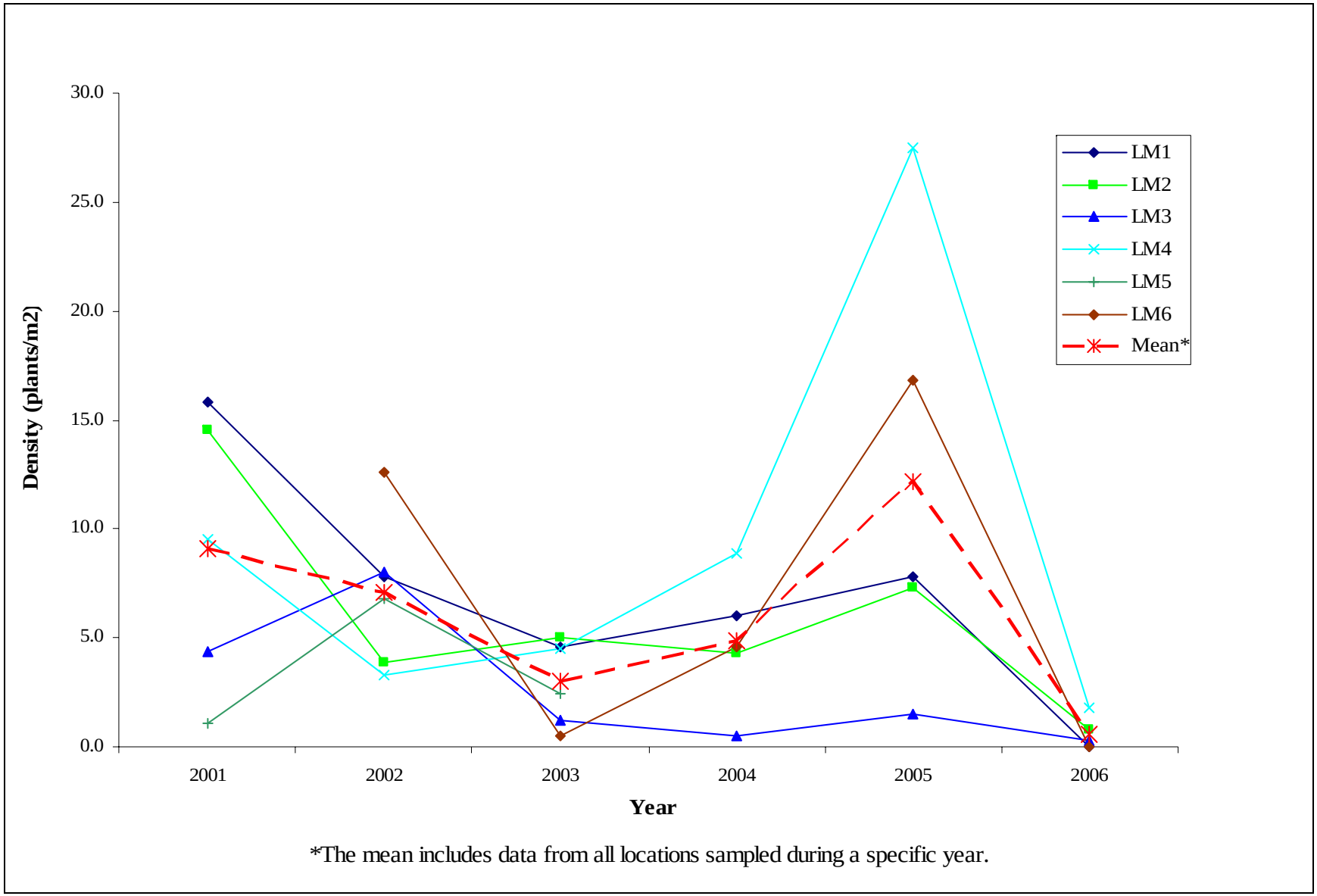
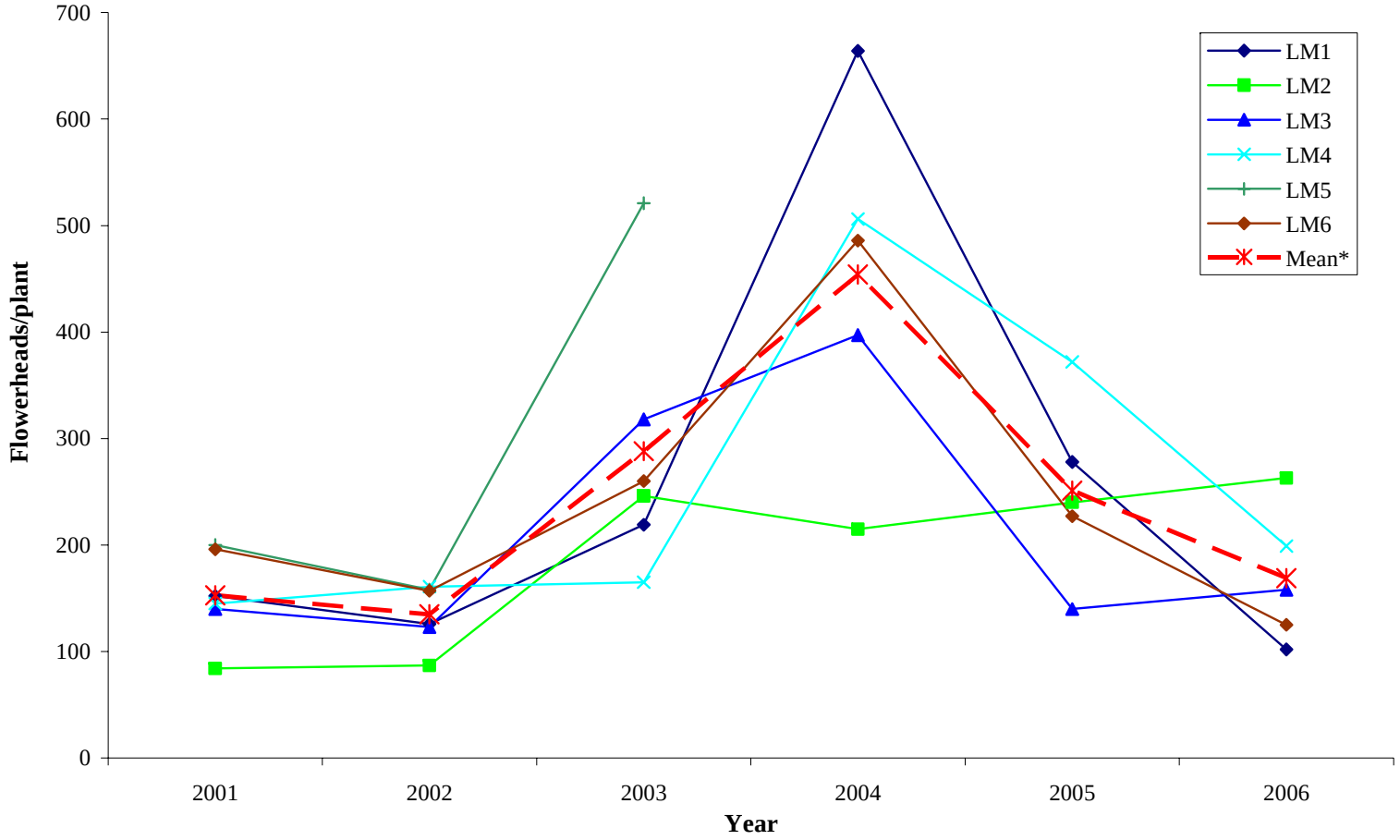


Figure 6–10. Diffuse Knapweed Density at Biocontrol Release Locations (2001–2006)



*The mean includes data from all locations sampled during a specific year.

Figure 6–11. Average Number of Diffuse Knapweed Flowerheads per Plant at Biocontrol Release Locations (2001−2006)

6.2.5.2 Seed Counts/ Insect Evidence

The average number of seeds per flowerhead (of the 500 flowerheads examined) across all five locations monitored in 2006 was 4.5 seeds per flowerhead, which is the highest number since seeds counts were initiated in 2002. From 2002 through 2005 the mean number of seeds per flowerhead was 0.91, 0.55, 3.08, and 0.58, respectively (Table 6−25, Figure 6–12). Seed production per flowerhead was significantly higher in 2006 ($p < 0.001$) compared to all the other years in which seed counts were performed. There was no significant difference in number of seeds per flowerhead between locations for 2006.

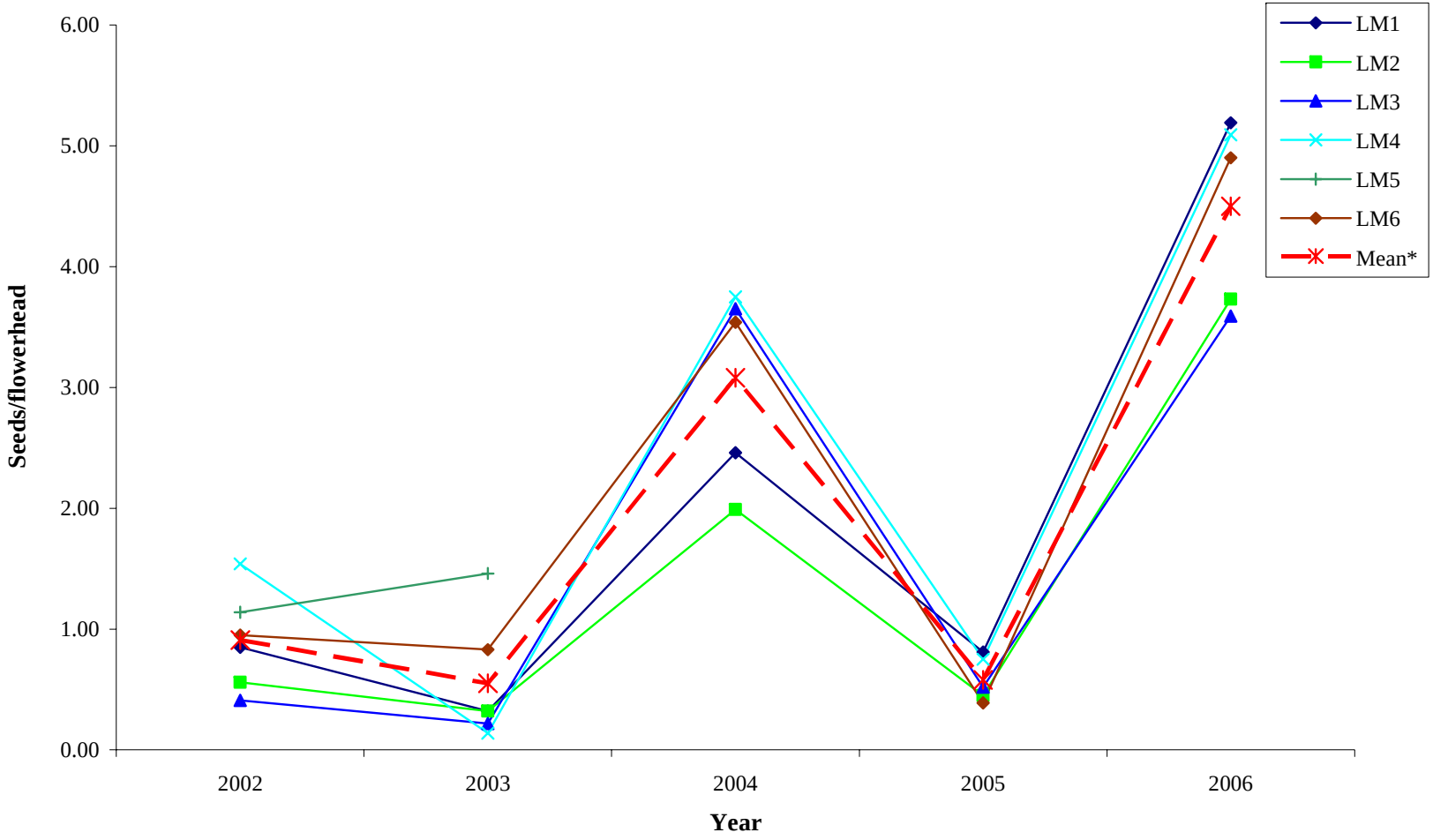
Table 6−25. The Average Number of Seeds per Flowerhead (out of 500 flowerheads examined) at Biocontrol Release Locations (2002−2006)

Location	2002	2003	2004	2005	2006
LM1	0.85	0.32	2.46	0.81	5.19
LM2	0.56	0.32	1.99	0.45	3.73
LM3	0.41	0.22	3.65	0.52	3.59
LM4	1.54	0.14	3.75	0.75	5.09
LM5	1.14	1.46	N/A	N/A	N/A
LM6	0.95	0.83	3.54	0.39	4.9
Mean	0.91	0.55	3.08	0.58	4.50

In 2006, the percent of flowerheads with evidence of insect damage was 19 percent (97 flowerheads out of 500 total). This is down from a high of 93 percent observed in 2003 (Table 6−26), which was significantly higher ($p < 0.001$) that year compared to the years 2002−2005. Percent of flowerheads with insect damage was significantly lower ($p < 0.001$) in 2006 compared to all the other years of the study (Figure 6–13).

Table 6−26. Percent of Flowerheads (out of 500 flowerheads examined) with Evidence of Insect Damage at Biocontrol Release Locations (2002−2006)

Location	2002	2003	2004	2005	2006
LM1	72	95	73	62	33
LM2	71	94	76	86	19
LM3	86	97	67	77	9
LM4	78	94	66	81	22
LM5	77	86	N/A	N/A	N/A
LM6	62	90	63	78	14
Mean	74	93	69	77	19



*The mean includes data from all locations sampled during a specific year.

Figure 6–12. Average Number of Diffuse Knapweed Seeds per Flowerhead at Biocontrol Release Locations (2002−2006)

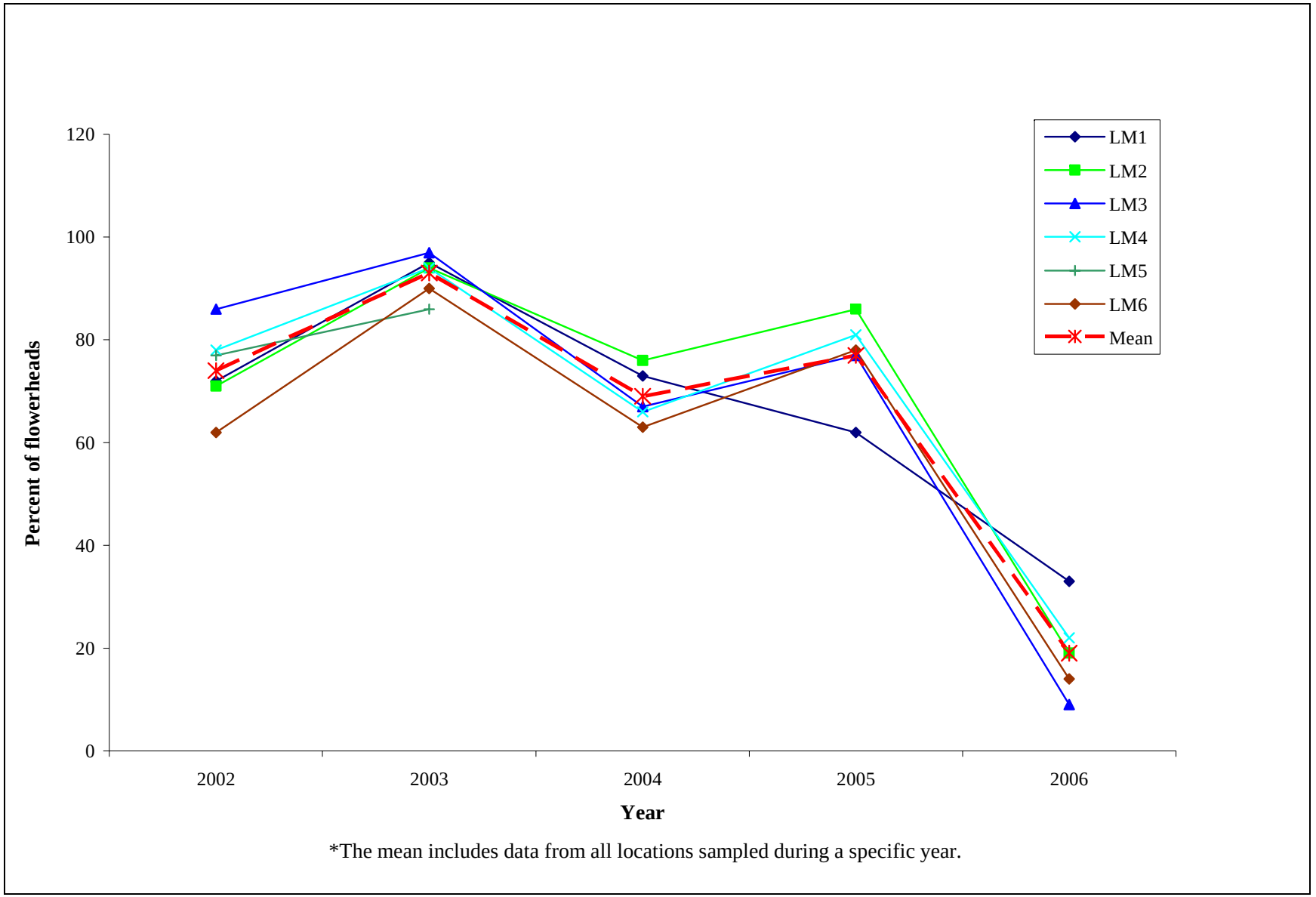


Figure 6–13. Percent of Diffuse Knapweed Flowerheads with Evidence of Insect Damage at Biocontrol Release Locations (2002−2006)

The average number of seeds per flowerhead for flowerheads with insect evidence and for flowerheads without insect evidence was also calculated (Table 6−27). In all 5 years, the overall number of seeds per flowerhead and flowerheads with insect damage, was statistically lower than for those showing no insect damage (2002 = $p<0.05$, 2003 through 2006 $p<0.001$).

Table 6−27. The Average Number of Seeds per Flowerhead (out of 500 flowerheads examined) at all Five Release Locations, calculated for the following categories: all flowerheads, flowers with evidence of insect damage, and flowerheads with evidence of no insect damage (2002−2006)

Year	Mean # seeds (all)	Mean # seeds (w/evidence)	Mean # seeds (no evidence)
2002	0.91	0.37	2.48
2003	0.55	0.14	5.66
2004	3.08	1.10	7.49
2005	0.58	0.21	1.82
2006	4.5	2.65	4.95

Table 6−28 shows the overall percentages of flowerheads in the following categories: no evidence of biocontrol insects, evidence of *Larinus* spp., evidence of *U. affinis*, evidence of *U. quadrifasciata*, and evidence of an unknown insect between the years 2004−2006. Evidence of multiple insect species damage to a flowerhead was found in three flowerheads in 2004 and eight flowerheads in 2005.

Table 6−28. The Percent of Flowerheads (out of 500 examined) at all Five Release Locations with the following flowerhead damage: no evidence of insect damage, evidence of Larinus *spp., evidence of* U. affinis*, evidence of* U. quadrifasciata*, and evidence of an unknown insect (2004−2006)*

Year	No evidence	*Larinus* spp.	*U. affinis*	*U. quadrifasciata*	Unknown insect
2004*	31	36	11	12	11
2005*	23	27	16	5	31
2006	80	3	3	12	2

Notes: *The total percentages sum to a slightly higher number than 100, due to the overrepresentation of three flowerheads in 2004 and eight flowerheads in 2005 that showed evidence of damage from multiple insects.

In 2004, the percent of flowerheads with evidence of the two species of *Urophera* and an unknown insect were about the same with about 11−12 percent each. Flowerheads with evidence of *Larinus* damage had the highest percentage, with 36 percent, and the remaining 31 percent of flowerheads showed no evidence of any biocontrol insect (out of 500 flowerheads collected). In 2005, the number of flowerheads with no evidence of biocontrol damage declined to 23 percent, as did the percentage of flowerheads with *Larinus* evidence (27 percent) and *U. quadrufasciata* evidence (5 percent). The only increases in percentages were in flowerheads with evidence of *U. affinis*, from 11 percent to 16 percent, and in flowerheads with evidence of an unknown insect. The increase in unknown insect percentage was the largest change of all categories, a three-fold increase from 11 percent in 2004 to 31 percent in 2005. In 2006 flowerheads with no insect evidence increased to 80 percent and *Larinus* and *U. affinis* evidence dropped to only 3 percent each. Unknown insect evidence was just 2 percent. These percentages were the lowest for those insect categories thus far during the study. Evidence of *U. quadrifasciata* increased to the 2004 level of 12 percent (Figure 6–14).

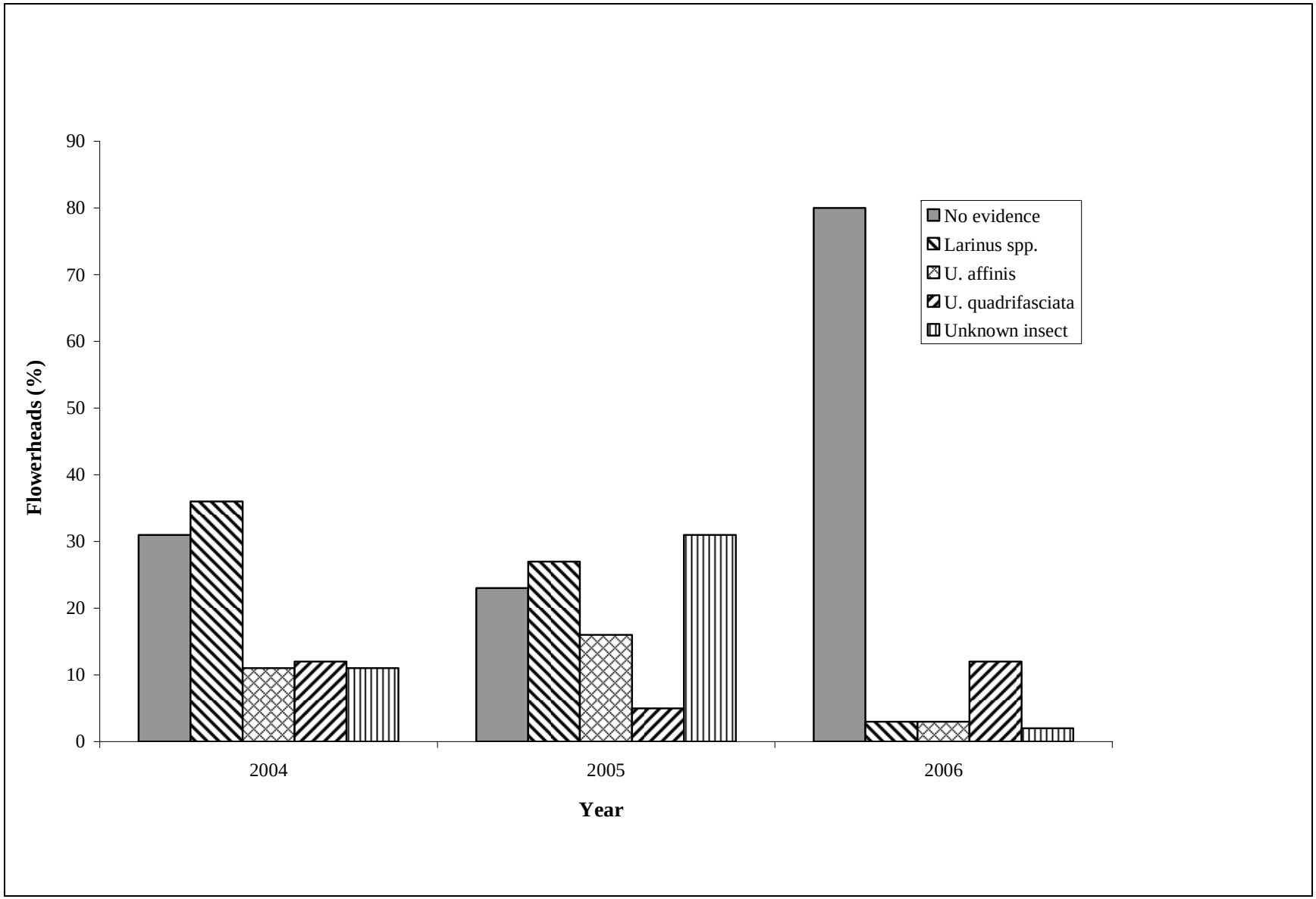


Figure 6–14. Percent of Diffuse Knapweed Flowerheads Divided into Insect Damage Categories at Biocontrol Release Locations (2004−2006)

6.2.5.3 Total Seed Production

Using knapweed plant density, the average number of flowerheads per plant and the average number of seeds per flowerhead, diffuse knapweed seed production per square meter was calculated (Table 6−29). From 2002 to 2003, the average seed production decreased from 892 to 473 seeds/m^2. The overall seed production then increased to 7,433 seeds/m^2, an almost 16-fold increase in 2004. In 2005, the overall seed production once again decreased to 2,363 seeds/m^2, still several times higher than the seed production at the time when the study began. In 2006 the overall seed production decreased to 784 seeds/m^2 (Figure 6–15). The data show large within site and annual variation in total seed production. As a result, only the increase in the grand mean from 2003 to 2004 is statistically significant ($p = 0.027$).

Table 6−29. The Average Number of Diffuse Knapweed Seeds per Square Meter at Biocontrol Release Locations (2002−2006)

Location	2002	2003	2004	2005	2006
LM1	835	322	9801	1756	529
LM2	191	394	1840	788	785
LM3	403	84	725	109	170
LM4	820	104	16888	7673	1823
LM5	1226	1827	N/A	N/A	N/A
LM6	1879	108	7914	1427	613
Mean	892	473	7433	2363	784

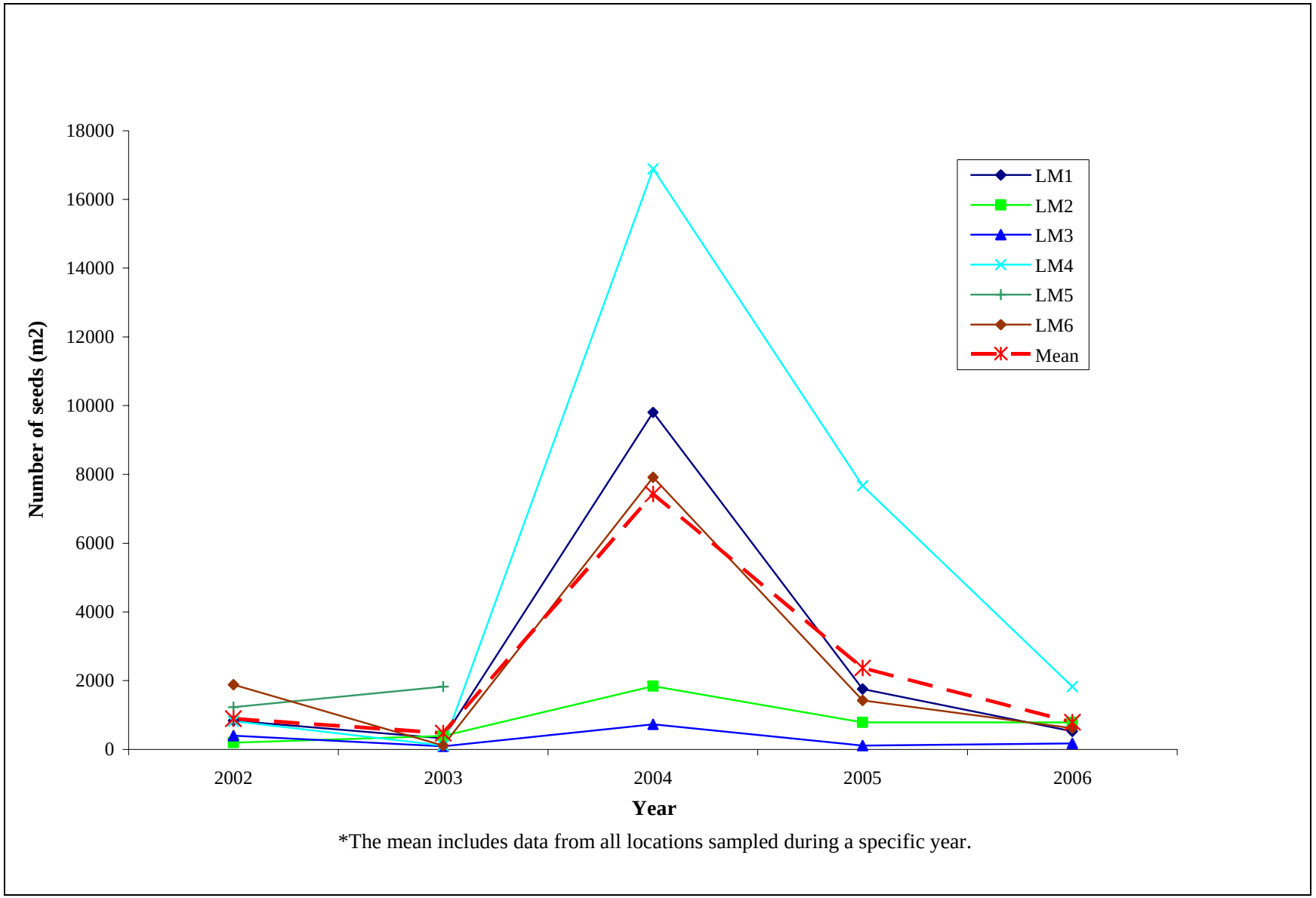


Figure 6–15. Average Number of Diffuse Knapweed Seeds per Square Meter at Biocontrol Release Locations (2002−2006)

6.2.5.4 Discussion and Summary

In general, the average cover of diffuse knapweed has declined at the release locations since the *L. minutus* were released. The greatest decline occurred initially the year after the releases were made and in 2006. Diffuse knapweed density also declined initially, but has not followed the pattern of the cover. Instead it began increasing in 2004 and continued to rise in 2005 to the point where it was above the level of when the study began. In 2006 both density along with cover declined to the lowest levels during the study.

There appears to be a correlation of the diffuse knapweed density data with the previous year's precipitation (November to October; Figure 6–16). Diffuse knapweed is a winter annual, often germinating in the fall, overwintering as a rosette, then bolting and flowering the following summer. In years with higher moisture, greater numbers of seeds germinate in the fall and survive through the following summer to be counted as adult plants (density counts are based only on the adults). Likewise, years with lower moisture show the opposite effect of decreased germination and density. From 2002−2003 density decreased with lower precipitation (11.99 inches and 13.16 inches, respectively), compared to 15.34 inches in 2001. In 2004 and 2005 precipitation increased to 22.83 inches and 19.35 inches, respectively, and knapweed density increased. In 2006 precipitation decreased to 10.65 inches and diffuse knapweed density once again decreased.

A comparison of cover versus precipitation suggests that cover generally follows the precipitation amounts for the same year (i.e., cover is higher with higher precipitation and vice-versa; Figure 6–16). This pattern was not maintained in 2004 and 2005, when cover did not increase with additional precipitation. In 2006 however, cover decreased once again with a decrease in precipitation.

One possible explanation for the 2004 and 2005 cover results was that the abundance of biocontrol insects had reached a level where they were starting to impact the diffuse knapweed plants. Not only do *Larinus* weevils destroy seed in the larval form, but they also forage on leaves and stems of the plant as adults. *Cyphocleonus achates* and *S. yugoslavica* are two other biocontrol insects that stress knapweed plants by affecting the root systems. In 2006 precipitation may have played a greater role in the decrease of cover and density than the biocontrol insects.

Flowerhead counts from 2002−2006 also appear to correlate well with annual precipitation received. With increased precipitation the number of flowerheads produced per plant increased and vice-versa (Figure 6–17). From 2002−2005 the number of seeds produced per flowerhead also followed precipitation amounts, for both flowerheads with and without insect damage. Then in 2006 overall seed production increased and was significantly higher compared to all the other years of the study (Figure 6–16).

Even though for 2006 the seed production results do not coincide with the results of other studies regarding seed production and precipitation (Seastedt et al. 2003, 2005 and Schirman 1981), the increase in seed production may be due to the lower percent of flowerheads with insect damage. In 2006, the percentage of flowerheads with insect damage was significantly lower when compared to flowerheads with insect damage for all other years. The average number of seeds found in flowerheads with insect damage in 2006 was the highest number for the study. In addition, evidence of *Larinus* spp., *U. affinis* and unknown insects in flowerheads were lower in 2006 than for other years (Figure 6–18).

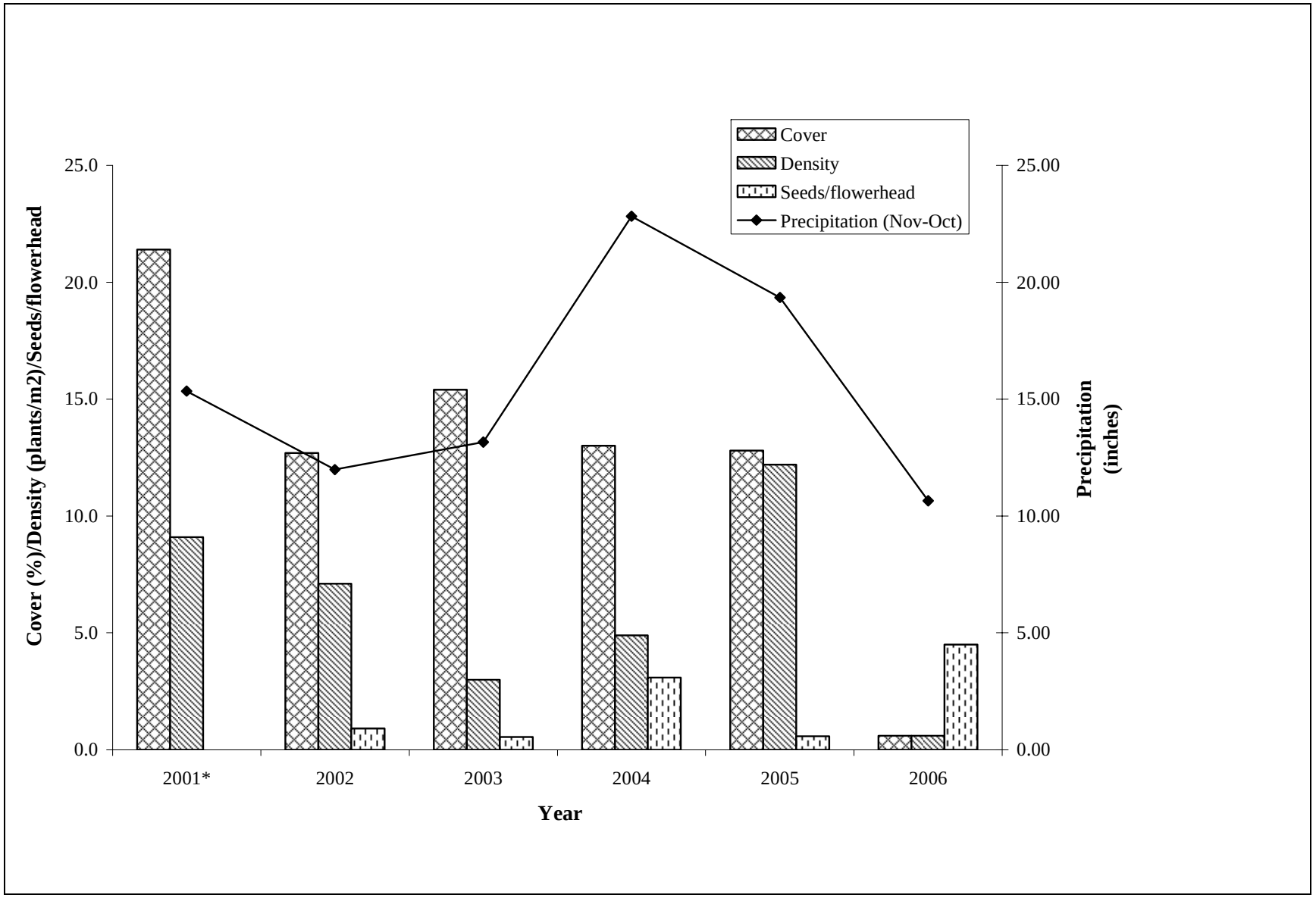


Figure 6–16. Rocky Flats Precipitation versus Diffuse Knapweed Cover, Density, and Number of Seeds/Flowerhead (2001−2006)

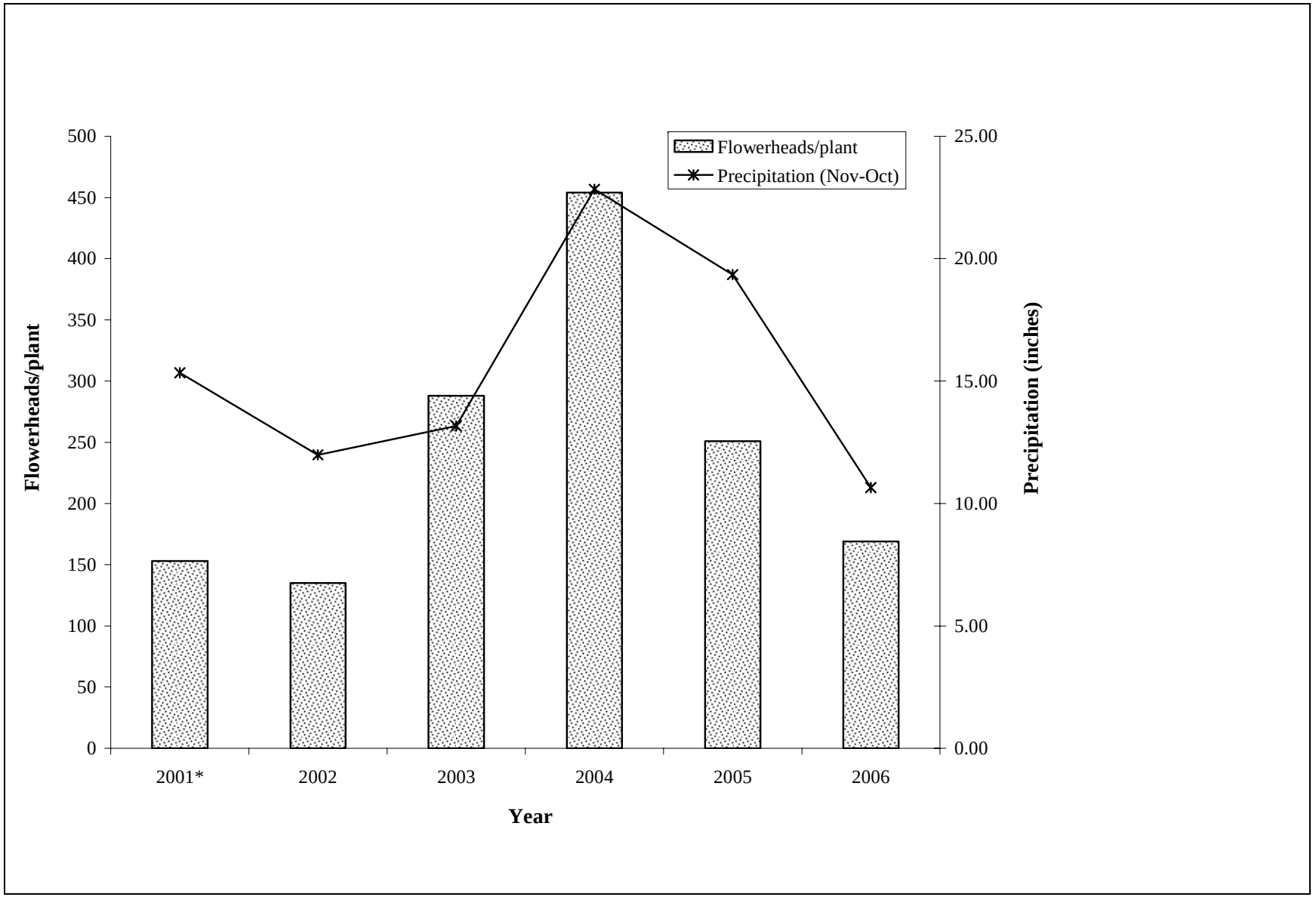


Figure 6–17. Rocky Flats Precipitation and Mean Number of Flowerheads/Plant of Diffuse Knapweed at Biocontrol Release Locations (2001−2006)

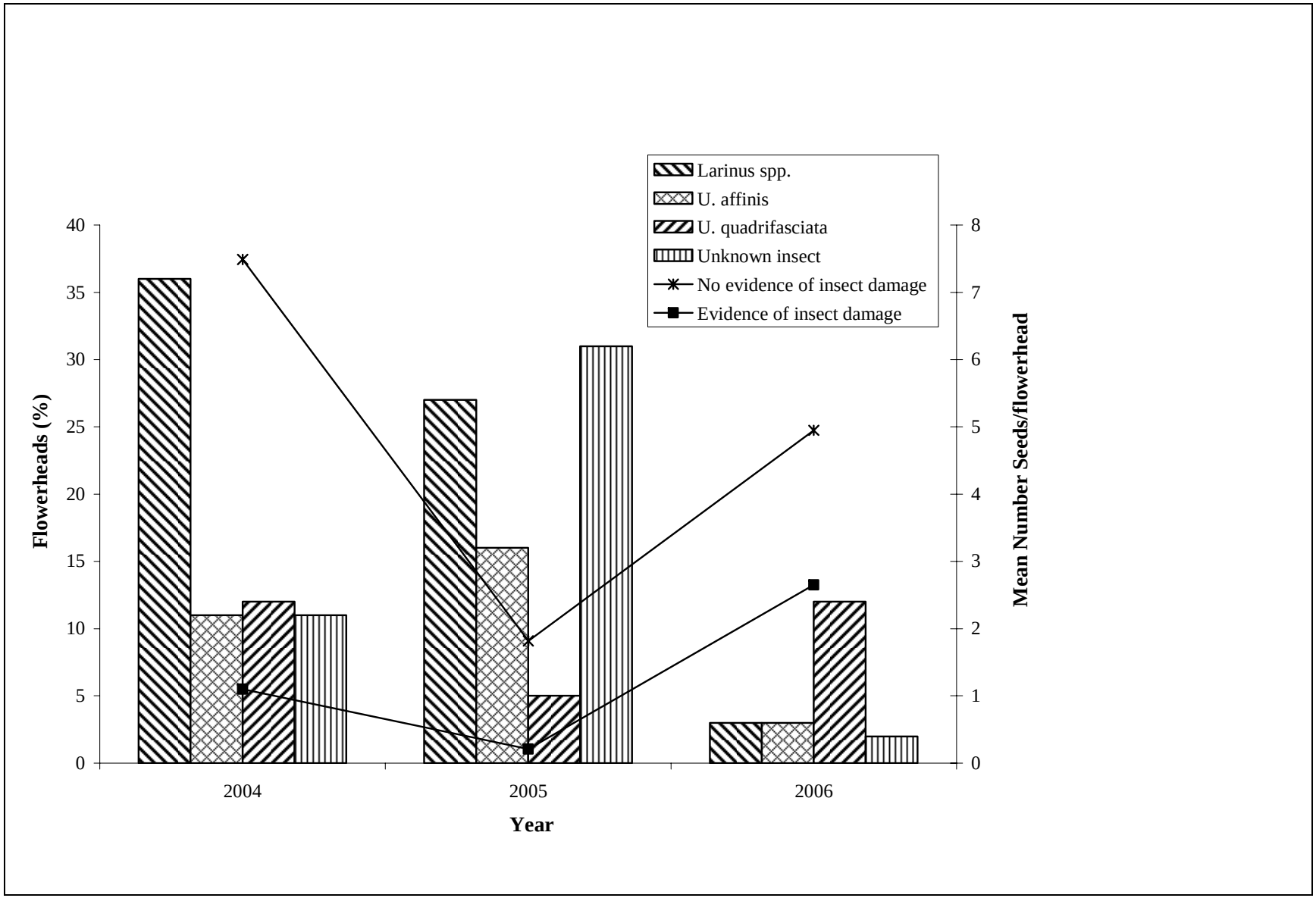


Figure 6–18. Percent of Diffuse Knapweed Flowerheads Divided into Insect Damage Categories and Mean Number of Seeds/Flowerhead with and without Insect Damage at Biocontrol Release Locations (2004−2006)

Seastedt et al. 2005 found that when *Larinus* weevil abundance is high, seed production is low, but when *Larinus* weevil abundance is moderate to low, seed production can vary from low to high. Also, *Larinus* weevils appear to lay few eggs in stressed plants, which could have been the case for 2006 as the November−October precipitation was the lowest since the study began.

Despite the fact that seed production per flowerhead was significantly higher in 2006 than in any other year, the average number of seeds per square meter was the second lowest during the study.

It typically takes 4−6 years after initial releases for the population levels of biocontrol insects to reach levels where they begin to have some effect on the target species populations. While the reduction in seed production is not as great as the biocontrol release study to the north of the Site on Boulder County Open Space land (Seastedt et al. 2003), the data show that the biocontrol insects appear to be having an affect on reducing knapweed cover and overall seed production at the Rocky Flats release locations as well.

The fact that the biocontrol insects have had some effectiveness in reducing the seed production of the diffuse knapweed at the Site is an important step towards controlling this annual species which reproduces by seed. The use of biocontrol insects alone will not likely completely control diffuse knapweed at the Site or most locations along the Front Range where it is problematic. However, biocontrol insects are one of several control methods for invasive species that can be used in conjunction with other control methods, or when other methods are inappropriate or not feasible.

6.3 Wildlife Monitoring

Wildlife monitoring has been conducted as part of the on-going ecological monitoring at the Site since the early 1990's. The frog vocalization survey was conducted on May 2, 2006.

6.3.1 Frog Vocalization Monitoring

Although occasional frog observations were noted while conducting general wildlife monitoring in the past, there were no specific attempts to monitor frog populations until 1998. Even though an annual presence/absence record for amphibians was being established as a part of general wildlife monitoring, the lack of a specific methodology precluded the ability to effectively track population abundance or distribution of these species at the Site. In an effort to better track amphibian populations and use that information as an indicator for detecting changes in the health of aquatic ecosystems, a systematic and recognized monitoring program was initiated that was based on nationally recognized protocol for monitoring frogs. Amphibians are an important group to track because their semi-aquatic nature makes them particularly sensitive to aquatic impacts (Blaustein and Wake 1995). The boreal chorus frog (*Pseudacris triseriatus)* was chosen as the best candidate at the Site for vocalization monitoring and can also serve as an indicator species for tracking general amphibian population abundance onsite.

In 2006, 20 locations were sampled for species presence/absence and population abundance on May 2, 2006 (Figure 6–19). Boreal chorus frogs were recorded at 11 of the 20 (55 percent) sample locations surveyed in 2006 (Table 6−30). Figure 6–20 shows the frequency of the different vocalization indices at all 20 locations sampled in 2006. Four of the locations (20 percent) sampled had full choruses of frogs calling (vocalization index 3). Four locations (20 percent) had multiple individuals calling with overlaps between the calls (vocalization index 2). Three locations (15 percent) had a vocalization index of 1, where individuals could be counted but the calls were not overlapping. The remaining nine locations (45 percent) had no frogs calling (vocalization index 0).

Table 6−30. Frog Vocalization Summary 1999−2006

Site Number	1999	2000	2001	2003	2004	2005	2006
1	3	2	1	1	3	3	1
2	3	2	3	2	2	3	2
4	3	2	3	0	1	1	0
5	3	3	3	0	3	3	0
6	3	2	2	2	3	3	0
7	3	2	3	0	3	3	3
8	3	3	2	0	3	3	3
9	2	2	2	0	1	1	1
10	3	3	3	3	3	3	0
11	3	1	3	1	3	2	2
12	0	3	1	2	3	3	3
13	3	3	3	3	3	3	3
14	3	3	3	2	3	3	2
15	0	2	2	3	0	3	0
16	0	1	3	1	0	0	0
17	0	0	1	0	2	1	0
18	3	2	1	2	3	3	1
19	2	3	2	1	0	3	0
20	2	3	3	0	3	3	2
21	0	1	1	0	0	0	0
Mean Vocalization Index	2.1	2.2	2.3	1.2	2.1	2.4	1.2
Grand Mean (1999−2006)	1.9						

Notes: Values are vocalization indices.

On the evening when sampling was conducted in 2006, the average water and air temperature (^{o}C) was 16^{o} and 16^{o}, respectively. No precipitation occurred on the day when sampling was conducted and the mean cloud cover was approximately 89 percent.

Table 6−30 and Figure 6–20 show the 2006 results in comparison to the data collected since 1999. The 1998 data is not shown because of the different sample locations used in 1998. The 2006 vocalization results tied for the lowest of all the years sampled thus far. The mean vocalization index in 2006 was 1.2 versus the annual mean of 1.9 (1999−2006; Table 6−30). Because the boreal chorus frog requires water to mate and lay eggs in, the overall abundance of the frogs at the Site appears be related to how much water is available at the Site during the

spring. From the available monitoring data, frogs were least abundant in 2003, the year after the drought in 2002 (Table 6−30, no data was collected in 2002). In 2004 and 2005, abundant precipitation resulted in higher abundances of vocalizations. However, during the fall and winter of 2005−2006, drought conditions were experienced again at the Site which left few locations with standing pools of water available for breeding in spring 2006. Additionally, many of the ponds at the Site were drained in midsummer 2005 for sediment sampling. The lack of precipitation after they were drained resulted in little to no water present at many of these locations. Although the 2006 data shows decline in the boreal chorus frog abundance at the Site, at this point there is no reason to assume it is nothing more than a normal perturbation resulting from the lack of water.

6.4 Summary

The Ecology Program at the Rocky Flats Site conducts monitoring of the ecological resources to ensure regulatory compliance and to preserve, protect, and manage those resources. Data from 2006 continue to substantiate the presence of increasingly rare ecological resources that are rapidly disappearing along the Front Range of Colorado due to development and urbanization. Proactive management of the natural resources is critical to the long-term sustainability of the ecosystems at the Site. Noxious weeds continue to be a top priority as does the revegetation of the COU. The monitoring results continue to provide useful information to assist in management activities. Full detailed summaries and analyses for each field monitoring effort are presented as stand-alone reports on the accompanying CD-ROMs.

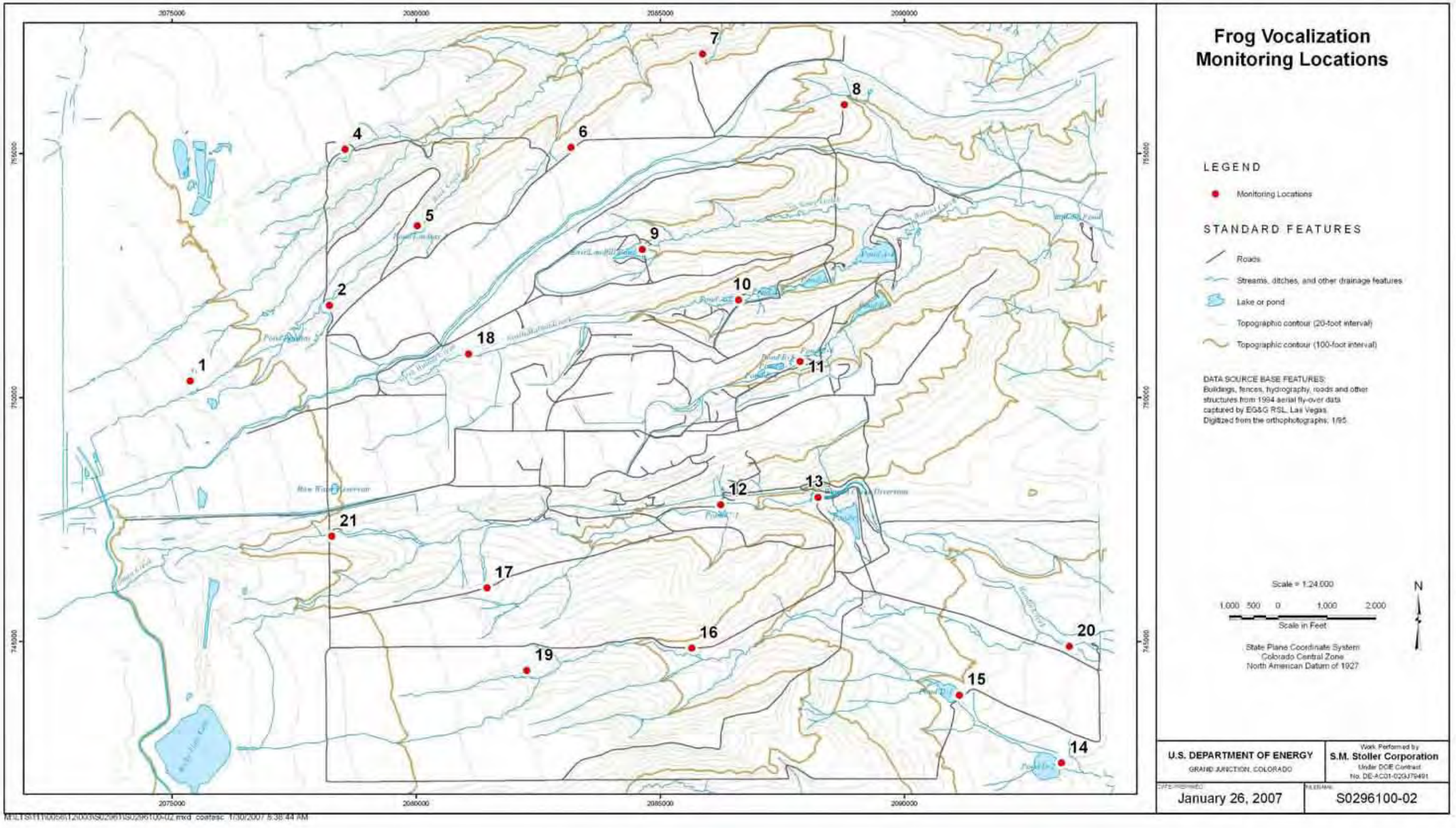


Figure 6–19. Frog Vocalization Monitoring Locations

This page intentionally left blank

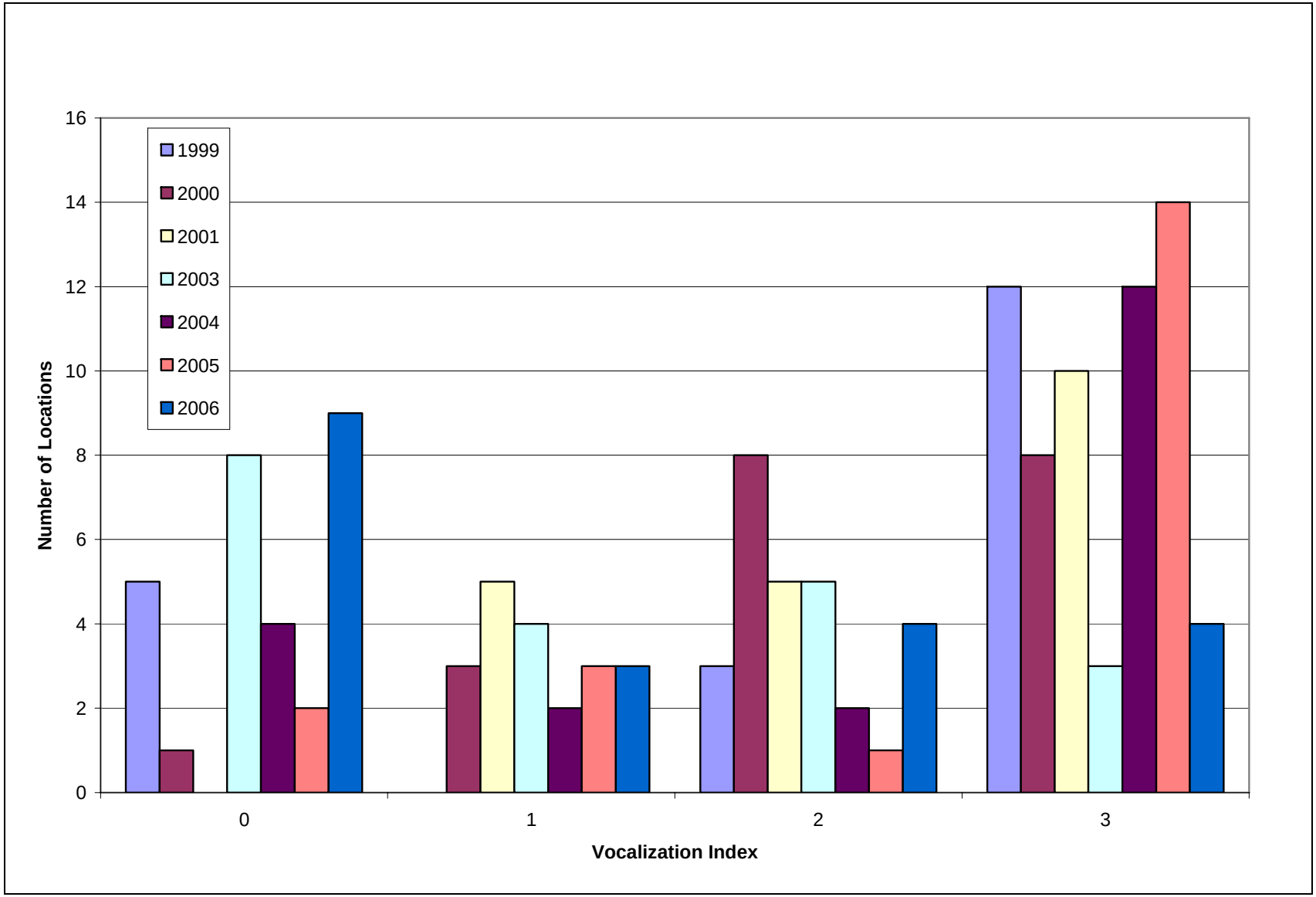


Figure 6–20. Frog Vocalization Summary

End of current text